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This report is the result of a conference on industrial arts called by the U.S. Office of Education. It contains eight working papers on significant problems and issues, followed by discussion highlights. The conference recommendations and suggestions to the professions are included, and provide a basis for action for improving industrial arts in the years ahead.

Industrial arts is important in our public school curriculum because it can 1) develop insight and understanding about the technological side of our American society for all students, and (2) discover and develop the technical talents possessed by some of the pupils in the schools. Instructional content should have more emphasis on the understanding of fundamentals of production and the application of mathematics and science in industry. Teachers should aim for more meaningful intellectual, as well as manipulative, experiences. Teachers should establish guidelines to be used as criteria to test the appropriateness of the content to be taught and projects to be undertaken. Suggestions for such guides are given. It is suggested also that special courses be established for academically talented pupils. Teacher-education institutions are advised to consider providing more preparation in mathematics and science, in industrial and economic history and geography, and in industrial sociology and psychology. In-service education programs also need to be developed. Continual redefinition and re-examination of industrial arts is called for in the light of current changes in society.

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# IMPROVING Industrial Arts TEACHING

## *A Call to the PROFESSION*

Conference Report
June 1960

MARSHALL L. SCHMITT, *Specialist for Industrial Arts,*
*Division of State and Local School Systems* . . . . .

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
ABRAHAM RIBICOFF, *Secretary*
Office of Education . . . STERLING M. MCMURRIN, *Commissioner*

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# Foreword

CURRENT CURRICULUM movements in the public schools of America and changes in our industrial society have created new problems and new relationships for industrial arts teachers. Because of this, the Commissioner of Education called a 2-day, work-type conference in Washington, D.C., June 20 and 21, 1960.

The topics developed for the conference were based on current problems and/or issues in the field of industrial arts. Many individuals and organizations participated in identifying the most significant problems for discussion and clarification. The recommendations and suggestions at the end of the report cite specific action for improving industrial arts.

E. GLENN FEATHERSTON,
*Assistant Commissioner,*
*Division of State and*
*Local School Systems.*

J. DAN HULL,
*Director,*
*Instruction, Organization, and*
*Services Branch.*

# CHAPTER I.

# Conference Working Papers and Discussion Highlights

## Introduction

**THE PURPOSE of the U.S. Office of Education Conference on Industrial Arts was to provide a fresh look at the profession's problems and stimulate a positive approach toward solving them—thus, resulting in *Improving Industrial Arts Teaching in the Public Schools*—the theme of the conference.**

**This report contains eight working papers which were prepared on significant problems and/or issues in industrial arts. The working papers deal specifically with the place of industrial arts in the American culture, objectives, guidelines for determining curriculum content, implications of Soviet polytechnic education, relationship of industrial arts to other school curriculum areas, meeting the needs of the gifted and slow learner, curriculum changes, and teacher competencies.**

**Following each working paper are *discussion highlights*. These highlights provide the reader with ideas expressed at the conference that clarify and supplement the individual working papers and the problems they represent.**

**The conference recommendations and suggestions summarize the main ideas which emerged from the working papers and discussion highlights, and provide a basis for action for improving industrial arts in the years ahead.**

**A list of the participants is included in the Appendix.**

# What Is the Place of Industrial Arts in the American Culture?[1]

### by

### R. Lee Hornbake

CULTURE may be defined as the way of life of a people. In this sense culture includes the basic values, cherished traditions, technics, and accomplishments among persons who acknowledge the sharing of these common attributes.

The development of a culture comes about through the creative efforts of persons who now live, or who have lived, within the group. In addition to these creative efforts, one group may borrow from another culture and integrate the borrowed feature within the culture.

A group of persons constituting a culture is difficult to circumscribe, although quite commonly a political boundary is specified. This procedure is somewhat arbitrary because of its exclusions as well as its inclusions. Canada and the United States, for example, present cultures which overlap appreciably. On the other hand, there are within the United States many subcultures which vary widely, particularly in their value patterns and in their drives.

Reference to "the American culture" implies a range of considerations which is almost incomprehensible since it includes all of the continuing adjustments the Nation has made and has practiced, and includes as well the borrowed adjustments, such as a large part of the "mother tongue." Despite the formidable nature of the task of definition, the effort is an important one since whatever distinctiveness there is in the American way of life is, correspondingly, the uniqueness of the American culture.

This search for the uniqueness of a culture would appear at first to be an academic concern deserving the attention of historians, cultural anthropologists, scholars of government and politics, and students of the arts. However, the fundamental relationship between culture and education makes the quest an urgent one for anyone interested in education. Education, simply stated, is the means whereby a culture re-creates itself.[2] The basic need of persons interested in education is to be apprised of the culture which is to be re-created. Purposes and procedures appropriate for American education can be understood and evaluated only as the basic components are identified and documented. "Industrial Arts in the American Culture" is deserving of our attention as a point of departure since some essential relationship must be established if Industrial Arts merits a place in the education of our children and youth.

---

[1] While the title and purpose of this paper developed from an analysis of current professional need, the present writer is obligated to refer to an earlier treatment of much the same topic.

In 1941, Prof. Boyd H. Bode presented a lecture entitled: "Industrial Arts and the American Tradition." This lecture became an Epsilon Pi Tau brochure bearing the same title. Professor Bode, on that occasion, identified the basic problem of this paper when he said: "My justification for appearing on this occasion is that we have a common problem. It is the problem of the larger context or framework within which industrial arts should be placed and in terms of which it should be appraised or judged. In other words, it is the problem of the significance of industrial arts in a program of education that is sensitive to the spirit of our American tradition."

[2] Quite obviously this relationship is an assumption. There are those who assume education to be a search for "eternal truths," truths which are unrelated to a particular culture.

In an authoritarian state education is used as an instrument of the state. To anyone who conceptualizes education as a development of individual talents and the liberation of the mind, the idea of harnessing education to the dominant cultural pattern and exploiting individuals by providing education as a reward for conformity is abhorrent. A democratic society operates on the hypothesis that the optimal individual good is also the optimal social good. When education is placed in this democratic context, we achieve an integration of the best evidence available on how man attains his personal maturity and a social order which supports his individuality. The idea is captured by Harold Benjamin in his titling of a book: *The Cultivation of Idiosyncrasy.*

The following quotations are supportive from an empirical viewpoint:

> "Education is viewed as integrally related with the culture of each period. To understand the education of any particular time or place one must understand the culture in which it operates."

R. FREEMAN BUTTS. *A Cultural History of Education.* New York: McGraw-Hill Book Co., Inc., 1947, p. 2.

> "Every system of thought and practice in education is formulated with some reference to the ideas and interests dominant or widely cherished in society at the time of its formulation."

NATIONAL EDUCATION ASSOCIATION, EDUCATIONAL POLICIES COMMISSION. *The Unique Function of Education in American Democracy.* Washington, D.C.: The Association, 1937. p. 6.

## Elements of a New Culture

Original settlements on the North American Continent along the Atlantic seacoast were made by Europeans. Quite naturally these settlers brought with them their Old World cultures. Reasons for the early settlements were greatly diverse ranging from adventure, to material aggrandizement, to the desire for freedom. As time went on, permanent settlements were made by persons coming as family groups and seeking to escape economic, political, and religious oppression. They expected to find or to create in the New World an environment which permitted the exercise of those human rights which their homelands had neglected or denied.

Migration, particularly migration involving great danger and isolation, is highly selective of persons who will face these dangers and uncertainties. The physical circumstances under which the settlers and their later counterparts lived constituted a further selective factor. A frontier home or frontier community far removed from the shop, out of reach of the craftsman, and remote from an abundant labor supply caused the individual settler to seek to satisfy his own material needs. Rewards for diligence and skill took the forms of material gain, self-respect, and personal recognition. The American frontier certainly was not a gentleman's paradise. A 1625 treatise by Lord Bacon, entitled "Essay on Plantations" commented: "The people wherewith you plant (colonies) ought to be gardeners, plowmen, laborers, smiths, carpenters, joiners, fishermen, fowlers, with some few apothecaries, surgeons, cooks and bakers." [3]

The world of practical affairs and men of practical abilities took on a new significance in early America. The dichotomy of a leisure class and a working peasantry, so characteristic of the Old World, made some progress in a few seaboard communities but even these traces moved out with the passing of the Royal Governors. The influences of the Reformation rather than those of feudalism predominated. While work and working conditions in Europe kept people in subjugation, work in the new nation developed as an avenue for freedom. The individual in the New World became what he was able to develop himself into being through his own efforts. By clearing land, by tilling the soil, by constructing his own shelter, by being a "jack of all trades" he was able to make his own way economically. More importantly, he was at the same time becoming a self-respecting and respected person.

As the frontier moved westward, as wars were fought, as factories and railroads were constructed, there was continual support for the man who was able to get the job done. Never before had the craftsman, the shipbuilder, the agriculturist, the practical inventor fared so well as did the American. Even the most critical foreign observer would acknowledge that the image of America was the man of action, a characteristic which became even more prominent between the 1850's and the Depression of the 1930's.

These developments were not at the expense of other cultural advancements. The Declaration of Independence and the United States Constitution, the extension of the voting privilege, the elimination of primogeniture, the separation of church and state were achievements which set new standards for the rest of the world to aspire to reach. The arts and journalism prospered, too, despite the time and energy needed to tame the wilderness and spread the Nation from the Atlantic to the Pacific.

While a brief summary of these developments can do little more than spotlight a few of the more significant elements, it is desirable to pause briefly to identify the main threads which tie together the evolving American culture.[4]

Perhaps first and foremost is the worth ascribed to the individual; he is important because he is a person different from all other persons. Society stands to benefit if his unique talents are developed and used in socially desirable ways.

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[3] Katherine Coman. *Industrial History of the United States.* New York: Macmillan Co., 1930. p. 41.

[4] Among our contemporaries President Harry Truman has commented as follows:

> Our national history began with a revolutionary idea—the idea of human freedom and political equality. We've been guided by the light of that idea down to this day. . . . This is the source of our strength. And this idea—this endlessly revolutionary idea of human freedom and political equality—is what we hold out to all nations as the answer to the tyranny of international communism.—*New York Times*, Oct. 18, 1950, p. 8.

The second major facet, complementary to the first, is faith in the intelligence of the common man. Here we have a society structured on the assumption that a person, properly educated and motivated, will participate effectively in making decisions which are in the common good. Furthermore, they will be better decisions in the long run than are those decisions which are made by one person or by a small, self-perpetuating "central committee."

The third element is the principle of the continual expansion of the decisions which the people generally are asked to share in making. All matters of public policy become a concern of the common man.

Perhaps the most self-evident observation which is suggested by these generalizations is the need for an educational system which will develop individual talents, which will lead to responsible behavior, and which will expand the individual's horizons.

## Educational Developments

While the founding fathers, such as Washington, Jefferson, Franklin, and Adams, recognized the importance of education to a democracy, they went to their graves without seeing much educational accomplishment to reward their hopes. Jefferson was able to claim the founding and heading of a college, and Washington gave part of his modest wealth to assist one or more institutions of higher education. Conditions were not conducive to the fulfillment of an educational pattern such as Jefferson had envisioned. The sparsity of population, the lack of wealth, the priority of everyday survival, and the general dislocation which follows war made the subject of schools little more than an academic consideration.

Much of the fundamental instruction which colonial children and youth received occurred outside the school. The same pattern prevailed after the birth of the New Nation. Youth learned seamanship by sailing with seasoned seamen, they learned agriculture by farming with their fathers and other adults, they learned crafts by working with craftsmen, they learned government by observation and through listening to discussions at home and in the town hall. Simple literacy was taught in the home by adults or by itinerant teachers; some efforts at teaching reading occurred under the auspices of churches. Supportive reading materials took the form of the Bible and related religious writings and the form of relatively abundant periodical literature such as the "penny press."

In any event, the rise of a public school system was not to come until the 1840's and then in only a few Northern States. However, there had long since been schools and colleges at least for the few. As early as 1636 Harvard College was established following the educational pattern of one or more of the Oxford colleges; the primary objective was an educated ministry, with liberally educated gentlemen a close second, or vice versa according to one's preference. Language, literature, and philosophy were predominant; instruction was conducted in the classical languages. At practically the same time preparatory secondary schools were fashioned and bore the descriptive title of Latin grammar schools. Although many Latin grammar schools were aided in some ways by government they remained private schools. Such schools and colleges had little to offer the great majority of the children and youth who comprised this frontier society. Their prevalence simply documents the conclusion that during this period education for the world of everyday affairs occurred outside the school.

Numerous "grand plans" for education were devised and laws were passed to promote education. The academy movement spearheaded by Benjamin Franklin did materialize as a significant development in American secondary education. Franklin, a man of many interests, numbered among his involvements association with the scholars of science and mathematics. Franklin was also a student of the needs of frontier communities. He saw about him seafaring people and thought it just and proper to have schools instruct in navigation. He was aware of the mercantilist bent of many Americans and proposed the teaching of commercial courses. Franklin's own academy later became a college and later the University of Pennsylvania. However, the academy movement was basically a secondary school which combined many of the language and literary elements of the Latin grammar school with courses in geography, history, mathematics, natural science, chemistry, and some practical subjects. Instruction was conducted in English. By 1850 the academy, basically a private institution but enjoying public support in many communities, had succeeded in enrolling a higher percentage of youth in secondary education than any nation had ever achieved.

Systematic primary and elementary education had not prospered as well and at no time had been organized. Parents, private tutors, itinerant teachers, charity schools, and church schools had contributed as much to the confusion of education as they had to the education of children. The concept of "graded" schools had not occurred and no formal content beyond reading and writing had been designated. Universal, publicly supported, secularly controlled elementary schools did not prevail until many battles had been waged for them. The commanding officers on the side of the children included James G. Carter, Horace Mann, and Henry Barnard. For most Northern States the issue was fairly well settled by 1850; a single-ladder system of education was conceptualized and the "little red school house" became its symbol. Refinements were made in methodology and in grading and pupil classification. In another 50 years the elementary school became a relatively efficient institution and even assumed part of the task of "Americanizing" millions of children born of immigrant parents.

The 3 R's were the elementary school's first stock in trade, but eventually there were added English grammar, history, geography, and other book-centered subjects. Some of the expressional arts and certain "manual" subjects were accepted, too, but it was not until the advent of the "activity movement" that the rationale developed for engaging the learner in the act of learning.

By the time from one to three generations of children succeeded in moving through the public elementary school the pressure was on to provide secondary education under public auspices. By this time, there was added to the voices of New Englanders a chorus from the States carved out of the Northwest Territory. Private academies were rather unrealistic solutions to their needs. The solution appeared to lie in the high school—an institution which Boston had devised in 1821. It was not until the post-Civil War period, however, that modern high schools came to be accepted as public high schools and were responsive to the needs of boys and girls who lived in a rural society. Terminal and practical education experiences were included in the curriculum. College preparation did not come to be a fundamental function of the modern high school until the Committee of Ten (1894) and the Committee on College Entrance Requirements (1895) became influential in the molding of the curriculum. After that there were two major influences in secondary education: (1) the phenomenal growth of the student body and (2) the advent of the junior high school with its strong insistence on exploratory experiences.

Colleges had not remained untouched. After many attempts to urge existing colleges to assume greater social-economic responsibility, the national emergency of the Civil War yielded the land-grant school which, along with State universities, constituted the capstone to American public education. These institutions did consider it appropriate to include in their offerings agronomy, bee culture, mechanical engineering, nutrition, textiles, chemistry, and a host of other economically oriented disciplines, including the professions. Students of the humanities were drawn together with students of civil engineering, animal husbandry, and "pre meds." These accommodations shoved into the background some of the relatively minor disputes in higher education which had centered about the elective system. Either unwittingly or consciously a new dimension had been added to education—the conceptualization and structuring of education to draw upon a variety of student talents and interests and the projection of these competencies into the mainstream of American life.

## The Look Ahead

Members of this conference need not be reminded of the genesis of Industrial Arts education; perhaps our best professional literature is in the area of history. It should be apparent to all that considerable difficulty has been experienced in developing a school system in keeping with our culture and consistent with our national goals. This is not to say that the American contribution to education has been inconsequential. However, the major achievements to date have been (1) universal education and (2) a single ladder system of administration from the elementary school through the State university. Educational purpose and program have responded to pressures of the times as well as to the classical tradition that schools should be essentially verbal-literary institutions.

Similarly, it is not necessary to report to this conference how intrinsic have become the "arts of industry" in our everyday life. We recognize industry as the source of our material goods and the bulwark of our standard of living. We acknowledge, too, that there are problems associated with the direction and control of industry, problems such as those which affect the role of the worker, the efficient use of our national resources, ethical advertising, the esthetic quality of the product, and built-in obsolescence. A defensible approach to the study of industry must include a cross section of contributions and liabilities.

In order to draw together, at least for purposes of discussion, some semblance of relationship between Industrial Arts and the American Culture, a series of three propositions are offered to focus attention.

## Proposition One

The fundamental concern of any people or nation is the continual evaluation of its educational effort; no other consideration is of equal magnitude since survival and progress depend upon the appropriateness and the effectiveness of the educational effort.

Quite obviously the educational effort of a complex society such as ours includes not only the formally identified educational institutions, such as schools, mass communication media, churches and synagogues, forums, and museums, but also the multitude of other places where behavior is influenced. The Halls of Congress, a political party convention, the labor meeting, the mill and factory, and the baseball game all influence the person's values, bear upon his formulating social, political, and economic understanding, and pertain to technical competence. It is only as this total effort is understood, the intrinsic inconsistencies identified, and the shortcomings noted that the role of the school can be postulated.

The dynamics of the world preclude a fixity in the educational effort. While there may be some temporary emotional security in retaining a familiar educational pattern, the demise of a culture is forecast the moment its education becomes inflexible.

Toynbee,[5] the historian, identified 26 civilizations which have developed during the past 6,000 years. Of these 26 civilizations, 16 are dead and 9 of the remaining 10 are arrested in their development. Toynbee's explanations of what happened to these civilizations are carefully presented in a series of volumes; hence, any simple statement approaching a generalization would be grossly unfair to his scholarship. An approximation of one of his hypotheses is that the continued vitality of a civilization lies in its ability to identify the basic problems of the society and then work out satisfactory solutions to them. These problems may be quite severe requiring an exertion on the part of those who work out the appropriate solution. In fact it appears that difficult rather than easy achievements make for a great civilization.

From Toynbee's investigations it became apparent that there must be a continual emergence within a culture of a creative element sensitive to the needs of the times and sufficiently resourceful to look for new approaches. These creative groups can appear only as the climate is cordial to their emergence. The educational opportunities available within the culture constitute the climate, either hostile to or supportive of the sensitive, creative children and youth.

Formal education is essentially conservative in nature. One generation of students becomes the teachers who bring along the next generation in much the same pattern as they themselves were taught. Furthermore, the "educated" members of society support the education they received as a means of reassuring themselves of their own adequacy. Changing cultural needs on one side of the balance and an intrinsically conservative education on the other side is simply another manner of expressing the need for the evaluation of our educational effort. Harold Benjamin[6] in his book *Under Their Own Command* presents a series of four measures of a people's education. The areas are (1) Measurement of Insight, (2)

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[5] Arnold J. Toynbee. *A Study of History.* (Abridgement of volumes I–VI by D. C. Somervell). New York: Oxford University Press. p. 578.

[6] Harold Benjamin. *Under Their Own Command.* New York: Macmillan Co., 1947. p. 26–31.

Measurement of Drive, (3) Measurement of Efficiency, and (4) Measurement of Significance.

Industrial arts education reflects a part of the changing cultural scene. The assessment and reassessment of education, when properly pursued, is almost certain to designate a place for Industrial Arts in the school's program as a part of the education of all children and youth. Other implications are cited in Proposition Two.

## Proposition Two

Industrial Arts, as a curriculum area, encompasses a segment of man's knowledge representative of his finest achievements, namely his capacity to create and perform techniques. A fundamental relationship between techniques and civilization has been expressed superbly by the historian, Good, in his statement:

> From the very earliest times, men must have taught their children the manual and domestic arts of gathering and preparing food and of constructing and using weapons, clothing, and shelter. Out of the skills which were developed to satisfy these basic needs, all sciences, arts and crafts, and industries have grown by successive inventions, discoveries, and refinement. A hungry man craves bread; a less hungry one will expect ice cream and cake. The road is long and winding from the cave and the shack to the Parthenon and the skyscraper but it is, nevertheless, the same road. Civilization and culture, including those intellectual phases which the Greeks called *paideia* and the Romans called *humanitas*, are the cumulative result of work done to satisfy first our basic needs and then those more subtle and refined needs and wants which have grown out of the elemental ones. Only by building civilization can man become fully human; and it is by work that he builds civilization.[7]

Brought up to date in a modern setting, many of the keys to understanding the problems among nations, matters of national defense, of community and personal health, of communication, of transportation reside in knowing something about the ways of industry. No one can read effectively the daily newspaper, the weekly news magazine, or an annual stockholder's report without some understanding of productivity, of the origins and applications of inventions, of production techniques. Similarly, the pleasures of everyday life are withheld from those who do not appreciate the finest of men's ceramics, silverware, furniture, graphic arts, as well as the precision products of a modern industry. The ability to perform in one or more of these arts is all the more rewarding.

This line of reasoning eventually gets around to some notion of what is a "cultured" person and the part which education plays in producing the cultured person. We propose the definition that a cultured person is one (1) who is adjusted to the environment in which he lives, (2) who is acquainted with the forces which influence his well-being, (3) who is eager to participate in controlling his own destiny, (4) who obtains from each experience an optimal meaning, and (5) who is able to make his way economically in a socially accepted manner.

Education is the process which yields the cultured person.[8] For convenience, education may be thought of as a segment commonly referred to as general education and another segment called special education.

> It (general education) is used to indicate that part of a student's whole education which looks first of all to his life as a responsible human being and citizen; while the term, special education, indicates that part which looks to the student's competence in some occupation. These two sides of life are not entirely separable, and it would be false to imagine education for one as quite distinct from education for the other.[9]

No sharp line separates the two aspects since, in the last analysis, it is the learner in his application of the learning which makes the delineation. For purposes of curriculum organization—a condition which is essential in running a school—general education pertains to those phases of the acculturation process which permits the person to meet his nonspecialized responsibilities to himself and to society. As mentioned previously, and as is highlighted in the Harry Good quotation, our environment is influenced appreciably by techniques of production and techniques related to production. Responsible participation in our society would appear, therefore, to draw quite naturally upon the subject area representative of the arts of industry, namely, Industrial Arts.

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[7] Harry G. Good. Education Through Work. Columbus, Ohio, Epsilon Pi Tau Brochure, 1943. p. 5.

[8] This approach, as stated previously, is based upon the integral relationship between the individual and society. Much the same destination is reached by the behavioral scientist as he explores the process by which a person develops his uniqueness or individuality. An excellent paper on this topic has been prepared by Walter B. Waetjen under the title of "The Exploratory Function of Industrial Arts Education."

[9] Harvard Committee. *General Education in a Free Society*, Cambridge, Mass., Harvard University Press, 1945. pp. 51–52.

## Proposition Three

Public education in the United States of America should be committed to the discovery and development of the talents of all boys and girls regardless of the nature and extent of the talents so long as the talents lie within socially accepted patterns. These talents among the many may be literary, mathematical, esthetic, mechanical, or scientific. Furthermore, the program of public education is obligated to assist in developing these talents to an optimal degree so that the individual may make his best contribution to society and so that he, as an individual, may lead a life of achievement and satisfaction. This principle strongly suggests that the school should provide a balanced program in terms of the range of human talents which may be explored.

Despite the data which continue to accumulate in the behavioral sciences—data which pertain to human motivation, to the diversity among pupils, to the diversity within the individual's makeup—schools have persisted in their verbal-literary emphasis and in the limited patterns of achievement which are rewarded. Furthermore, the pressures of the day are used by adults to channelize children and youth. A recent instance of national scope is the sudden educational emphasis on selected sciences and mathematics following Russia's entrance into outer space. National policy and national preferences were not examined to determine why the Russians had preempted this field. Somehow the quick conclusion was drawn that more American children should get more science and mathematics at an earlier age. The science instruction offered to children and youth has been a modified version of the science they are to be taught later. No overall *program* of science education has yet emerged, despite the activity of many individuals. One essential element is a critical attitude on the part of those persons who are most directly concerned in the program. In my opinion, diverse approaches to the discovery of science talent have been neglected in the process and in this neglect the major purpose of the quest has been compromised.

Other examples may be cited to document the principle that we need a broad educational program in our schools, representative of the talents we seek to discover and develop. Our educational drive and energy should be in this direction. Otherwise, we channel our children and youth in subtle ways to make the selections which adults champion and reward, with little regard for the aptitudes of individuals. The free enterprise system is not likely to operate in the market place if it is neglected in the education of children and youth.

The case for industrial arts in American education is that when properly presented as a discipline, it does represent at several maturity levels a challenge to a pattern of abilities which part of the population possesses. This cultivation of these abilities is essential to national progress and security. These abilities are essentially creative and expressional in nature. When combined with complementary abilities of abstraction, in mathematics, in science, or in the arts, the result is persons capable of inventive genius and effective production.

## Discussion Highlights

**In the years ahead, say 50 or 60 years, we will look back and say, "The real measures of an educational system are: (1) measurement of insights, (2) measurement of drive, (3) measurement of efficiency, and (4) measurement of significance."**

**Understanding "production techniques" gives insight into some of the problems faced by the Nation. For example, if a newspaper states that a large airplane used by the military will no longer be needed, and then at a later date in the same newspaper, an article cites the establishment of a new program with a newly designed airplane, what does this mean to the average person? If the average individual has no notion about production techniques, he will not be able to comprehend the delay involved in getting production started on a new airplane. He will not have the insight to visualize the problems of rehiring, retraining, retooling, etc. These concepts are vital to understanding the high productivity of an industrial nation.**

**Public education should be committed to the discovery and development of the talents of all boys and girls. It is strange, when you think about it, that in the making of the atomic bomb, during World War II, the basic development work was done by many individuals who were not Americans. For many years, in this country, much of our research was applied research. We were interested in how to put things**

together, and how we would make them work—a machine, an automobile, an extension of a new bumper, or a hi-fi set. It has been only recently that we have come to the realization that basic research is important for discovering new informaiton.

What has this to do with the Conference on Industrial Arts? The function of this working paper has been to show the relationship of education to our democratic concepts, and in particular to show how industrial arts as a curriculum area contributes to the fulfillment of America's purpose. The paper also identifies selected works, such as those of Good, Bode, and Waetijen, that extend, amplify, and further clarify the purpose and place of industrial arts in the educational scheme.

Industrial arts is a part of the common learning needed by all responsible citizens. It has general educational value for each individual. Nevertheless, there is no sharp distinction between general education and special or vocational education. It is the learner in his application of the learning that makes the difference. Vocational education, generally, is that part of a student's education which develops his competence in some occupation.

Exploring, from an individual's standpoint, to discover his special talents is quite another matter. This has meaning to a person as he develops his uniqueness or individuality. Knowing oneself is a mark of a cultured person. Industrial arts must provide learning at different educational levels to challenge the patterns of abilities that part of the population possesses. This is in keeping with our cultural needs and beliefs.

Although we are well aware that individuals possess many different kinds of talent and express themselves creatively in varying ways, creativeness sometimes emerges from what is thought to be the lower level of intellect. Why is it that talents other than verbal are not recognized fully in school? Psychologists have recognized many different aspects of the intellect. There seems to be difficulty in distinguishing between creativity and intelligence.

There is so much that a cultured person should learn about our industrial society that industrial arts cannot be delegated only to the junior high school level. It must be available at all instructional levels.

Would industrial arts be acceptable as a course in liberal arts colleges, like mathematics, social studies, and science? Perhaps it would be if the right kind of program and a teacher were available to do the job. Would the States accept it as a part of the liberal education of a cultured person? It is strange that the predominant characteristic of our society is our industrialism—our capacity to produce goods in large quantities—and yet the schools do not develop a good understanding of this aspect of our society. Would not a person in the 20th century, in describing this era of American history, indicate that one of the dominant factors in the United States was the impact of the arts of industry on our life? Yet a study of this dominant aspect has been relegated to the students who are less intellectually able to assimilate the nature and implications of this instruction.

New justifications are needed for the industrial arts curriculum. Isn't it true that liberal arts people say that they, too, provide an understanding of our technical culture through courses like physics, and social studies? No doubt, these courses do contribute to the overall understanding in different ways than industrial arts. Industrial arts experience actively engages the student in a life-learning situation which, from a psychological standpoint, enhances the learning taking place. These experiences, involving content not taught in other curriculum areas, give insight into the tools, machines, and industrial processes basic to our technical society. And, in addition, they provide for the discovery and development of technical abilities possessed by students.

The technological advances have brought new devices to aid the learning process. These devices attempt to involve the learner more in a "learn by doing" situation. But research has not yet established the real effectiveness of these devices.

Is industrial arts for all students or it for a few with particular abilities? In viewing the Smithsonian Institution, one gets the impression that technology affects everyone. Technology is part and parcel of the culture—it cannot be separated. Is not an understanding of technology with all its implications essential for everyone?

Developing objectives for industrial arts is an area of the curriculum that needs real thinking and reasoning. A look at the analysis of industrial arts objectives, which were developed between 1928 and 1960, reveals that certain objectives keep reappearing in the literature within the categories of consumer knowledge, avocational-recreational interests, skill-techniques, social habits and attitudes, exploration, and others. These objectives, if fulfilled, would enable a person to understand our technology.

One of our problems has been to find ways for able students to take industrial arts. We are stereotyped with an organization of 1 hour a day, 5 days a week. Why not fewer periods for the more advanced students? There are some things that should be done in a shorter period of time. Also, we have had the experience of offering a course where neither credit nor grade is given. The better students will attend whether they get credit or not. The important point is to see a need and develop a course to fulfill the need.

It has been brought out previously that when production in a major industry is halted the effects are far-reaching. The background of the industrial arts teacher should enable him to impart an understanding of these effects to his students. Industrial arts has given him a sound preparation and an intimate knowledge of the ways of industry. Potentially, therefore, he is the man to impart this knowledge. But teacher education must be improved in order to do the job effectively.

As a result of guidance in junior high school, some feel that individuals who do not possess verbal skills automatically possess manual skills. This is an assumption, but generally accepted without question. As mentioned in the working paper, industrial arts must be rethought so it will make full educational sense in the American culture, or it will be reduced to a program of caretaking for slow learners. All factors must be taken into consideration by guidance personnel when program decisions are made.

Language arts is in the curriculum so that students can learn to communicate; mathematics so they can calculate; science so they can understand the laws of the universe; but an understanding of another area of life—technology—is not so well established as a must in the total curriculum. Many students do not get this experience in their schooling to the degree they need it, yet these very students will become the voters and school board members in the future and will, in part, control the schools' programs. The study of technology must become a part of all students' "general education" so they can fully understand its implications and place in society.

The dichotomy between academic and nonacademic courses seems artificial. Needed is a reappraisal of the imperative needs of youth as described by the secondary school principals—then an analysis of the characteristics of youth and the development of a program. Education should not be compartmentalized as academic, nonacademic, or special. Anything can become special if it contributes to the specific needs of a youngster.

With regard to teaching techniques, there must be opportunity for learning the principles of the techniques involved. A technique is a way of doing something—techniques emphasize training. Principles require understanding which can be applied to both familiar and new situations.

# What Objectives Should Be Emphasized in Industrial Arts?

*by*

***Ivan Hostetler***

THERE IS widespread concern today for improvement of every aspect of education in the American public schools. This concern is shared by many in industrial arts education. Among them are those who are carefully scrutinizing industrial arts education—its meaning, function, and objectives—to determine its place in the general education of all American youth.

For any program of education to be improved, it must first be evaluated in terms of its objectives. Thus it becomes necessary to define the objectives of a program clearly and have these objectives understood and implemented by the teachers. The organization of any course, the content, the method of teaching, and the evaluation must be based on these objectives.

Because of the relative importance of objectives to the improvement of a program of industrial arts education in our public schools, many questions are being raised concerning objectives of which the following are typical: (1) What objectives should be emphasized? (2) Should the objectives differ at the various age and grade levels? (3) Should they differ for the slow learner and the superior student? (4) Should the objectives be reevaluated and limited to four or five? (5) Should the objectives be limited to those that are unique to industrial arts? (6) Should industrial arts in the senior high school have a vocational objective? (7) What is the relationship of the commonly accepted objectives, and what goes on in the industrial arts laboratory? (8) Do the programs based on present objectives attract a complete cross section of high school students? It is the obligation of the profession to try to find the answers to these questions.

While we recognize the need for clearly defined objectives for industrial arts, the big problem confronting many teachers is to select, out of a large array of objectives, those that are unique, attainable, and likely to achieve desired results. This is one of the problems which professional industrial arts educators should try to resolve.

It shall be the purpose of this paper at least to attempt to find some of the answers to this problem by (1) reviewing the development of industrial arts objectives from 1928 to 1960, (2) reviewing studies on objectives, (3) reviewing the thinking of some of the industrial arts leaders on objectives, and (4) listing some of the objectives which should be emphasized with the reasons for their selection.

## Development of Industrial Arts Objectives from 1928 to 1960

The first 50 years of the present century produced the most spectacular technological growth in the history of our country. Fifty-eight percent of the people industrially employed today are working at jobs that did not exist 50 years ago. Automobiles, airplanes, refrigerators, radios, television sets—just to name a few—are products of the first half of this century. While the technological changes have been phenomenal, industrial arts education which, according to Bonser, is "a study of these changes," has progressed at a much slower pace.

A study of the objectives of industrial arts of this period shows that some of the emphasis and claims made for industrial arts have changed while others remain essentially unchanged. A review of the objectives emphasized at different stages of this period may throw some light on what objectives should be emphasized today.

In 1928 Warner[1] made an extensive study of industrial arts objectives to determine which ones were used during the 50-year period preceding 1928. Fifteen objectives selected were as follows:

- A. Exploration.
- B. Educational Guidance.
- C. Vocational Guidance.
- D. Consumer Knowledge and Appreciation.
- E. Household Mechanics.
- F. Social Habits and Attitudes.
- G. "Pre-Vocational" Purposes.
- H. Avocational Purposes.
- I. A Degree of Skill.
- J. The Seven Cardinal Principles.
- K. Mechanical Intelligence.
- L. Correlation with Other Subjects.
- M. Developing the "Faculties."
- N. Coordinating the "Hand and Eye."
- O. Vocational Training.

A jury of experts and 358 Ohio teachers selected objectives A through I (omitting G) as relatively more important for the junior high school than the remaining objectives, although questions were raised concerning the importance or unimportance of objectives B, C, G, K, and L. They did consider relatively unimportant objectives G and J and disapproved M, N, and O.

For senior high school industrial arts, B and C were uniformly accepted as being pertinent, while both approval and uncertainty were expressed about the following: A, D, F, G, H, I, K, and O. The remaining objectives, E, J, L, M, and N were rejected.

The publication, *Industrial Arts, Its Interpretation in American Schools*,[2] published in 1938, gives the following objectives for industrial arts:

In the Junior High School:

1. Provides information regarding industry and workers.
2. Reveals employment opportunities offered by industry.
3. Satisfies the boy's and girl's desire to create useful things.
4. Develops hobby and handyman interests and abilities.
5. Contributes to the tastes and judgment of the prospective consumer.
6. Develops interest and ability in home repairs and maintenance.
7. Affords practice in safety related to the school, home, and industry.
8. Gives opportunity for cooperative effort in groups.
9. Illustrates and vitalizes the academic subjects.

In the Senior High School:

1. Develops an appreciation of design and quality in manufactured products.
2. Provides practice in the use of materials and tools for recreation and home utilization.
3. Samples a variety of industries, through advanced school courses, in preparation for entrance as a beginner into the skilled trades or into college courses in engineering and architecture.

Nine suggested objectives for industrial arts are given in the *American Vocational Association* (AVA) publication, *A Guide to Improving Instruction in Industrial Arts*.[3] They are:

1. *Interest in Industry.*—To develop in each pupil an active interest in industrial life and in the methods and problems of production and exchange.
2. *Appreciation and Use.*—To develop in each pupil the appreciation of good design and workmanship and the ability to select, care for, and use industrial products wisely.
3. *Self-realization and Initiative.*—To develop in each pupil the habits of self-reliance and resourcefulness in meeting practical situations.
4. *Cooperative Attitudes.*—To develop in each pupil a readiness to assist others and to join happily in group undertakings.
5. *Health and Safety.*—To develop in each pupil desirable attitudes and practices with respect to health and safety.
6. *Interest in Achievement.*—To develop in each pupil a feeling of pride in his ability to do useful things and to develop worthy leisure-time interests.
7. *Orderly Performance.*—To develop in each pupil the habit of an orderly, complete, and efficient performance of any task.
8. *Drawing and Design.*—To develop in each pupil an understanding of drawings and the ability to express ideas by means of drawing.
9. *Shop Skills and Knowledge.*—To develop in each pupil a measure of skill in the use of common tools and machines and an understanding of the problems involved in common types of construction and repair.

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[1] William E. Warner. *Policies in Industrial Arts Education, Their Application to a Program for Preparing Teachers.* Columbus, Ohio, The Ohio State University Press, 1928. p. 34.

[2] *Industrial Arts, Its Interpretation in American Schools.* Washington, U.S. Government Printing Office, 1938. (U.S. Department of Interior, Office of Education, Bulletin 1937 No. 34) p. 41, 61.

[3] *A Guide to Improving Instruction in Industrial Arts.* Washington, D.C., American Vocational Association, 1953. p. 18.

Wilber[4] in 1948 formulated the following nine objectives of industrial arts:

1. **To explore industry and American industrial civilization in terms of its organization, raw materials, processes and operations, products, and occupations.**
2. **To develop recreational and avocational activities in the area of constructive work.**
3. **To increase an appreciation for good craftsmanship and design, both in the products of modern industry and in artifacts from the material cultures of the past.**
4. **To increase consumer knowledge to a point where students can select, buy, use, and maintain the products of industry intelligently.**
5. **To provide information about and, insofar as possible, experiences in the basic processes of many industries, in order that students may be more competent to choose a future vocation.**
6. **To encourage creative expression in terms of industrial materials.**
7. **To develop desirable social relationships, such as cooperation, tolerance, leadership, and "followership," and tact.**
8. **To develop safe working practices.**
9. **To develop a certain amount of skill in a number of basic industrial processes.**

Comparing these objectives which were debated in 1928 with the objectives found in some of our latest State and local industrial arts publications may reveal the progress, or lack of progress, we have made on this fundamental aspect of industrial arts education.

The following list of objectives is taken from one of the most recent State bulletins[5] on industrial arts released August 1959:

1. ***Knowledge and Industrial Procedures.*—To develop an interest in and an understanding of representative industrial environments through information, observation, and study of methods, materials, and processes of industrial production and distribution.**
2. ***Consumer Knowledge or Related Information.*—An evolutionary improvement in the knowledge and ability of prospective consumers in reference to appreciation, selection, care, and use of all industrial materials.**
3. ***Skills and Techniques.*—The development of skills and techniques in the use of common tools and machines; and a working knowledge of the qualities and characteristics of the most often used materials sufficient for the purpose of fulfilling the needs of an average citizen.**
4. ***Exploratory Opportunities.*—Exploring and finding values through developmental shop or laboratory type experiences, revealing student interests and aptitudes for possible vocational pursuits, leisure-time activities, or the selection of other courses in school.**
5. ***Appreciation.*—Experiences leading to the development of a background which permits understanding and response to such problems as appropriateness of material to use, quality of workmanship, good design, taste, and function.**
6. ***Leisure-Time Interests.*—To develop within the student an awareness of the variety of tasks performed in our industrial environment, and the interesting possibilities of continuing with some form of the activity as a hobby.**
7. ***Vocational Guidance.*—A program of study, visual aids, and field trips to various industries, and development experiences, affording opportunities to discover individual aptitudes, abilities, and interests.**
8. ***"Handyman" Activities.*—To develop household mechanics or handyman abilities through dexterity in the use of tools and materials in making ordinary repairs to household equipment.**
9. ***Planning.*—The development of a habit of orderly procedure in planning any task intelligently.**
10. ***Desirable Habits and Attitudes.*—The development of desirable personal and social values through participation in a shop-type organization where desirable work habits, attitudes, and social relations are a direct outcome.**
11. ***Pride and Interest in Accomplishment.*—To develop in each individual an attitude of pride and interest in his ability to do useful things and a personal responsibility for property and its care.**
12. ***Prevocational Purposes.*—A sampling of industrial training undertaken in advanced school courses with the intention of acquiring further training within a specific vocation.**
13. ***Social-Economic Cooperation.*—To inculcate each individual with a knowledge and realization of the interdependence of people, of the need and value of social harmony and cooperation through group activities, projects, and studies.**
14. ***Self-Expression and Problem-Solving Attitudes.*—The stimulation of creative self-expression and problem-solving attitudes through encouragement and opportunities to plan and construct useful articles in suitable materials.**

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[4] **Gordon O. Wilber. *Industrial Arts in General Education.* Scranton, Pa., International Textbook Company, 1948. pp. 42–43.**

[5] ***Mississippi School Bulletin, Industrial Arts for Mississippi High Schools—Grades 7–12,* Division of Instruction, State Department of Education, Jackson, Miss., 1959, pp. 15–16.**

15. *Vitalization of Academic Subjects.*—To unify learning and enrich the academic subjects by bringing theory and practices closer together through the use of creative workin the shop.

In a recent release of a *Teaching Guide for Industrial Education*[6] for a large city system, the following objectives are listed for the elementary and secondary levels:

1. To provide experiences with tools and machines typical of modern industry so students can explore and test their interests and abilities in industrial work.
2. To develop the handtool and machine skills in shopwork and drafting that represent good current industrial practice.
3. To develop social understanding and ability to work with others as a leader or as a cooperative member of the group.
4. To develop wholesome personality balance by integrating the child's mental, emotional, and physical growth and training.
5. To develop the skill of recognizing quality and good design in manufactured products.
6. To teach the essential elementary skills and scientific concepts necessary to keep the commonly used products of industry in efficient and safe working order.
7. To develop the tool skills and knowledge necessary to plan and construct useful projects with common handtools, simple machines, and construction materials in a workmanlike manner.
8. To develop an interest in handicraft as a valuable medium for creative expression in leisure hours.
9. To develop skill in reading and in making drawings, charts, and graphs.
10. To provide an objective medium for implementing learning in the fields of mathematics, science, language arts, and social science.
11. To develop a feeling of pride in and appreciation of quality in workmanship.
12. To encourage traits of inventiveness and ingenuity in dealing with tools, materials, and simple machines.

In 1959 the State of Florida published *A Guide—Industrial Arts in Florida Schools*[7] in which are listed the following objectives for industrial arts:

1. Knowledge of the overall impact of industry upon society primarily through planning, design, and production in the laboratory.
2. Development of basic skills with tools and equipment commonly used by people in solving everyday problems of home living and also development of proper and safe attitudes and habits of work with tools, equipment, and materials.
3. Development of the interest and talents or discovery of the limitations of students through instructional shopwork in a variety of materials and processes which relate to future occupational choices.
4. Development of the ability to select, use, and maintain equipment and goods produced by industry and used in everyday living, such as tools and machines, motors and engines, and electrical and household appliances.
5. Promotion of wholesome and worthwhile interests and abilities in creative and constructive work with tools and craft materials for leisure-time and hobby activities. All activities in industrial arts classes should promote social experiences in working with others and afford opportunities to share, lead, plan, take responsibility, and cooperate in group activities.

Olson[8] in his *Technology and Industrial Arts* gives the following functions of industrial arts:

> The functions of industrial arts are statements of the purposes for which industrial arts is intended and to which it is assigned; they together become its mission. They represent a crystallization of the aims, objectives, and goals of industrial arts. About the aims, purposes, objectives, and goals for industrial arts there seems to be a rather general agreement throughout the profession; disagreement arises over implementation.
>
> The six functions, also called "Objectives and Guiding Principles," defined in the *Ohio High School Standards for Industrial Arts Education* for Junior and Senior High Schools, are essentially those as accepted for this study. They are: The Orientation Function; the Technical Function; the Avocational Function; the Consumer Function; the Social Function; and the Cultural Function. Their content is described in the following statements:
>
> > *The Orientation Function.*—Experiences in industrial arts should help the junior and senior high school pupil become better oriented in an industrial society by exploring many types of tools, materials, processes, products, and occupations. Manipulation should be primarily a

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[6] *Teaching Guide for Industrial Education—Kindergarten Through Secondary School.* Chicago, Ill., Board of Education, 1959. pp. 3–5

[7] *A Guide—Industrial Arts in Florida Schools.* Bulletin 12, State Department of Education, Tallahassee, Fla., 1959. pp. vi–vii.

[8] Delmar W. Olson. *Technology and Industrial Arts.* Distributed by Epsilon Pi Tau, University Station, Box 3111, Columbus, Ohio, 1957. pp. 77–78.

means for promting other ends. Habits and skills derive their value from appropriate use. The emphasis is rather upon obtaining a pattern of knowledge, attitudes, habits, skills, and understandings essential to individual and group welfare in a technological society. One of the basic outcomes of the orientation function is its value in assisting the pupil in making an occupational choice which may lead him into vocational preparation in the final years of his educational program.

*The Technical Function.*—Industrial arts should provide as many opportunities as possible for pupils to spend at least a year in any phase of work where orientation may help to define specialized interests that can be pursued with profit. The opportunity, for example, should be provided for a pupil to delve into the intricacies of cabinet or furniture making, electrical communication and power, lighting, automotives, printing a monograph, making a cabin or a boat including drawing the design and writing the specifications, designing and making a small machine, studying the occupational possibilities of certain local industries, or any similar problem or group of related problems in one or more areas of the industrial arts program.

*The Avocational Function.*—Industrial arts also provides opportunities to cultivate a wide variety of useful, wholesome, and enduring leisure-time interests and activities. Collection and appreciation is involved in addition to manipulation. The importance of this function is increasing. There is now almost as much time for leisure as for labor and sleep together. Increased leisure time affords not only an educational opportunity but it also becomes a liability and a responsibility with which the school must cope.

*The Consumer Function.*—A primary purpose of industrial arts is to aid the individual in developing intelligent attitudes and understandings concerning the selection and use of the products of industry. This involves studies and experiences covering a variety of topics and problems ranging from the production of raw materials, through the processes and problems involved in their manufacture, to the distribution of finished products and their wise use by the ultimate consumer. It should and must help him achieve consumer literacy since he needs to live intelligently in the midst of an involved technology.

*The Social Function.*—Experiences in industrial arts through activities in the shop or laboratory, as well as outside, should help the student develop desirable social habits and attitudes. The program is concerned, for example, with helping pupils understand and formulate wholesome opinions toward such things as integrity of workmanship, sanitation, housing, wages and hours of labor, safety, preservation of natural resources, or any other related social problem.

*The Cultural Function.*—Experiences in industrial arts should help the individual enjoy a finer culture as regards materials in an involved technological society. This means helping him develop and use his material inheritance. For example, the pupil can learn to know style or design in architecture, furniture, rugs, pottery, silverware, glass, dress, china, printing, machinery, and other items of common use, and appreciate the forces that have influenced them. With a cultured taste, he is prepared to surround himself with those things from which he can derive lifelong satisfaction.

Those functions adopted for this study are: The Technical Function, the Consumer, the Occupational, the Recreational, the Cultural, and the Social. The function of orientation is not included as one of the list because it is an inherent part of each of the functions and can best be provided for in that relationship.

The occupational function is included in the recommended list because it is felt that it is sufficiently important to stand by itself. This phase of the mission is included in the technical function as described in the *Standards,* and in the orientation function, also.

## Studies on Objectives

Robinson [9] in his study on *Trends in Industrial Arts Teacher Education* based on a survey of teacher-training institutions raised the following questions pertaining to industrial arts objectives:

> Are the AVA objectives for industrial arts sufficient for our present program? Seventy-nine of the 84 respondents replied to this question. Fifty-two, or 66 percent, agreed that the objectives were sufficient, while 24, or 30 percent, thought some changes should be made, and 3, or 4 percent, were doubtful. Some who apparently were satisfied made qualifying statements on how the objectives might be implemented to meet the changing trends and emphasis in industrial arts education. They indicated that objectives may have to be modified to correlate more closely with their program.

On the other hand, those who did not agree with the AVA objectives were very definite in their opinions on how they should be revised. The belief was expressed that objectives should not be written by an organization, but rather by the

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[9] Walter J. Robinson. *Trends in Industrial Arts Teacher Education,* A Survey of Teacher Training Institutions. Natchitoches, La., Northwestern State College, 1959. 33 p.

"thousands who teach the subject." Those who teach subject matter must be motivated to write objectives.

In 1955 Shaw[10] wrote a thesis on the subject, *Emphasis Placed Upon the Unique Objectives of Industrial Arts at Byrd and Fair Park High Schools.* It is a report of a study based on the assumption that there are certain objectives unique to industrial arts, and the study was made to determine how well these unique objectives have been met. Results of the study were based on the opinions of 47 experts in the field of industrial arts and 220 former industrial arts students of Byrd and Fair Park High Schools. The data for the study were collected through a questionnaire based on the nine AVA objectives.

Briefly, some of the conclusions were as follows: The experts, in general, agreed that the following objectives are more nearly unique to industrial arts: (1) *Shop Skills and Knowledge;* (2) *Drawing and Design;* (3) *Interest in Industry;* and (4) *Appreciation and Use.* However, they believe that the remaining five objectives could be equally well realized through other general education courses. These five are: Orderly Performance; Interest in Achievement; Health and Safety; Self-Realization and Initiative; and Cooperative Attitudes.

Only two of the objectives the experts found to be most nearly unique, viz, Appreciation and Use and Drawing and Designs. These had been stressed at the two high schools. Both the experts and the students agreed that the objective, Self-realization and Initiative, is not unique to industrial arts.

## Contemporary Statements

It is encouraging to hear what some of our leaders have to say concerning industrial arts objectives. If action will result from those who hear these voices, improved programs will result. The voices speak:

> If industrial arts can't offer something that is *distinct, different, important, and significant* to the education of every boy, then indeed we are failures. . . . We must have a program that makes sense to the students, parents, administrators, business and professional men, and *most of all* to ourselves. Our major objectives must make *distinct* contributions to general education. We *shouldn't stress the same general objectives that could be applied equally well to social studies, physical education, home economics, art, or any other subject area.* And it doesn't make much sense to say that we do a better job with these objectives than *with* the other subject areas. It is not enough to say that we can teach cooperation, leadership, self-reliance, etc., better than social studies can, for example. . . .
>
> Industrial arts can be a *distinctive* part of every boy's education. It can contribute something that he can't learn in any other area. What are some of the things that only industrial arts can do?
>
> 1. It can teach the student to use and think with tools and machines.
> 2. It can teach him to read and use two kinds of languages, the technical language of industry and the language of drawing.
> 3. It can teach him about the basic materials of industry.
> 4. It can teach him about the occupational opportunities in the many areas of our industrial economy.[11]
>
> . . . No one can lay a rightful claim to being an educated person today unless he has come to understand some of the components of an industrial society. Many of these understandings are learned at the college level in economics courses, in sociology courses, and in the physical sciences. However, higher education continues to serve only a small part of the total population. In addition, the usual instructional approach associated with the teaching of economics and sociology is to study about these phenomena rather than to engage the learner directly. Industrial arts instruction, when designed to achieve these ends, can provide significant learning experiences in these and other timely areas for all, or nearly all, of the secondary school population. In substance, our first social responsibility is to help our children and youth understand the world in which they live. Industry is a very dominant element in this society.
>
> Our second social responsibility pertains more directly to the development of the individual. Boys and girls, when considered as a group, possess a great diversity of talent. In fact, all the talents which are available for society to draw upon are inherent in our children. . . .
>
> . . . The one most certain way of discovering talents is to provide experience situations in which these talents may appear. . . . And so, too, must we provide experiences in technical education if we wish to discover technical abilities. It is not possible to infer unknown special abilities from known special abilities: talents are *discrete entities.*

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[10] Bernace L. Shaw. Emphasis Placed Upon the Unique Objectives of Industrial Arts at Byrd and Fair Park High Schools. Unpublished Master's thesis, Natchitoches, La., Northwestern State College, 1959. p. 95.

[11] John L. Feirer. Let's Take the Offensive. Editorial, *Industrial Arts and Vocational Education* (June 1960). p. 13.

**Shop teaching should begin with a problem approach. Man has developed tools and machines and has learned to modify materials to meet human needs and wants. At first these needs were elemental and pertained to shelter and protection against the elements. As these elemental needs were met, more complex ones were resolved. Any time we use tools and materials, we should be setting out to solve a problem, unless the purpose is sheer busy-work. As we try to solve problems we must be creative in the sense that we are resolving the problem for our first time. . . .[12]**

**Let us face up to ourselves, to our prejudices and biases, as we look to the future. Let us find a unity in our mission, a unity based on our answers to the question: Just what should we be doing for the boy and girl if we want them to develop into the kind of people needed to keep America great and to increase its greatness?**

**It seems to me that we have little choice. Either we rethink industrial arts so that it makes full educational sense in the American culture or we will be reduced to a program of caretaking for the slower children.**

**. . . I propose that we take a new look at our mission and, in so doing, cut ourselves free from our ties to the past and look ahead to a service which cannot yet be fully seen but which, our faith in the basic concept of industrial arts tells us, is there. Only then can we strike out with a bold new program that we can honestly know all America needs.[13]**

**The fact of technology as the dominant element in the culture and the social complexities which it brings will be afforded increasing importance in deriving educational goals. While numerous activities in the school will be responsive to this, consideration of the technological aspect of the culture will lead to a central, integrating purpose in industrial arts for the great majority of youth who study industrial arts at the junior and high school levels.**

**. . . The preceding statements are strongly suggestive of the need for a central, integrating purpose in industrial arts. They also suggest that for each of the special industrial arts offerings there should be a purpose which is clear, realistic, and attainable. A long list of objectives for industrial arts as a whole is meaningless. If agreement can be reached concerning the objectives and emphases to which each phase of industrial arts should be responsive, progress can be made in determining what content and activities, methods and facilities are most appropriate for each. Some degree of standardization can occur only if the meaning and purposes of industrial arts can be validated and if the criteria for determining content, methods and facility can be evolved and rigorously applied. There must always be room for new developments on the forward edge of industrial arts, however, if programs are to be kept sensitive to current developments in the technological aspect of the culture.[14]**

## Objectives Yesterday and Today

The 15 specific industrial arts objectives given in the *Mississippi State Bulletin* were taken from a study made by Warrick [15] in 1947. These objectives were classified as to their relative importance by 286 teachers of industrial arts from cities with populations of 10,000 or more. From a total of 37 objectives, 15 were selected.

In comparing these 15 objectives with the 15 used by Warner in his study of 1928, one finds that 8 of the latter are included in the present-day list of objectives suggested in the new *Mississippi State Bulletin*. Although the experts of 1928 raised serious questions concerning the importance or unimportance of one objective (Vocational Guidance) and considered another unimportant ("Pre-Vocational" Purposes), both of these are found in the *1959 list*. The 1928 experts also definitely disapproved "*Household Mechanics*" as an objective for the senior high school, but this also is still included.

While some of the recent State and city industrial arts bulletins list even more objectives than were recommended by Warner's study in 1928 (15), a review of other lists shows a tendency of combining related objectives, thus reducing the number. Florida's recent State bulletin limits its number of objectives to five and Olson's list includes six. The listed objectives are not only reduced in number, but are also more nearly unique to industrial arts.

The table shows that two objectives, "Consumer Knowledge" and "Avocational Interests" were included in all eight lists of objectives, and all but one listed the "Skills" objective. "Social Habits

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[12] R. Lee Hornbake. Professional Growth in Industrial Arts Education. *The Industrial Arts Teacher* (November–December 1959), p. 13.

[13] Delmar W. Olson. A Call to Industrial Arts. *School Shop* (June 1960) p. 9.

[14] M. Ray Karnes. Improving Industrial Arts Education. *The Industrial Arts Teacher* (May–June 1960), p. 5.

[15] Glenn D. Warrick. Industrial Arts Objectives. *Industrial Arts and Vocational Education,* 36: 287, September 1947.

**and Attitudes" was included in six lists. This would seem to indicate that these four objectives are still considered important and will continue to be emphasized. The objectives, "Exploration" and "Vocational Guidance," were included in five lists, and objectives "Appreciation of Good Design and Workmanship," Correlation with Other Subjects," "Satisfies Desire to Create," and "Understanding of Industrial Society" in four lists.**

**From the study of the developments of industrial arts objectives over a period of years, one may piece together the following:**

1. **Four objectives are considered about as important today as they were 50 years ago.**
2. **There is a tendency to combine related objectives thus reducing the number which are also more nearly unique to industrial arts.**
3. **Of the 15 objectives listed in 1928, 8 are included in recent lists of objectives.**
4. **Several objectives rejected in 1928 are included in recently approved lists.**
5. **There is a definite change reflected in the thinking on objectives as illustrated by the Florida and Olson lists.**

***An Analysis of Industrial Arts Objectives Developed Between 1928 and 1960***

| Source | Objectives | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Exploration | Educational Guidance | Vocational Guidance | Consumer Knowledge | Household Mechanics—Handyman | Social Habits and Attitudes | "Pe-Vocational" Purposes | Avocational-Recreational | A Degree of Skill—Techniques | Mechanical Intelligence | Correlation with Other Subjects | Vocational Training | Satisfies Desire To Create | Safety and Health | Appreciation of Good Design—Workmanship | Understanding of Industrial Society | Self-Realization and Initiative | Interest and Pride in Achievement | Planning—Orderly Performance | Drawing and Design | Social-Economic Cooperation | Self-Expression—Problem Solving | Wholesome Personality Balance | Inventiveness—Ingenuity | Discover and Develop Talents |
| Warner | X | X | X | X | X | X | | X | X | X | X | X | | | | | | | | | | | | | |
| Proffitt | | | X | X | X | X | | X | | | X | | X | X | | X | | | | | | | | | |
| AVA | | | | X | | X | | X | X | | | | | X | X | X | X | X | X | X | | | | | |
| Wilber | X | | X | X | | X | | X | X | | | | X | X | X | | | | | | | | | | |
| Mississippi | X | | X | X | X | X | X | X | X | | X | | X | | X | | | | | X | X | | X | X | |
| Chicago | X | | | X | | X | | X | X | | X | | X | | X | | | | | X | X | | X | X | |
| Florida | | | | X | | | | X | X | | | | | | | X | | | | | | | | | X |
| Olson | X | | X | X | | | | X | X | | | | | | | X | | | | | | | | | |

## What the Leaders Say About Objectives

1. **Industrial arts should offer something that is distinct, different, important, and significant to the education of every boy.**
2. **Industrial arts objectives must make distinct contributions to general education.**
3. **Industrial arts should not stress the same general objectives that could be applied equally well to social studies, physical education, home economics, arts, or any other subject area.**
4. **No one can claim to be an educated person today unless he has an understanding of some of the components of our industrial society.**
5. **Our first social responsibility is to help our children and youth understand the world in which they live.**
6. **Our second social responsibility is to help boys and girls discover and develop their talents.**

7. One of the most certain ways of discovering talents is to provide experience situations in which these talents may appear.
8. Using tools and materials in industrial arts should be related to problem solving, otherwise it becomes sheer busy-work.
9. We must rethink industrial arts so it will make full educational sense in the American culture or we will be reduced to a program of caretaking for the slow learner.
10. We must take a new look at our mission, free ourselves from ties to the past, look ahead to a service not yet fully seen but which, our faith in the basic concepts of industrial arts tells us, is there.
11. Technology as the dominant element in our culture and the social complexities which it brings will be of increasing importance in deriving industrial arts objectives at the junior and senior high school levels.
12. Every industrial arts offering should have a purpose which is clear, realistic, and attainable.
13. A long list of objectives for industrial arts as a whole is meaningless.
14. If agreement can be reached concerning the objectives and emphases to which each phase of industrial arts should be responsive, progress can be made in determining what content and activities, methods, and facilities are appropriate for each.

## Industrial Arts

A. An Outlook

Education for the individual may be divided into the following areas:

(1) Communications (language, English, mathematics), (2) The Theoretical Sciences, (3) The Social Studies, (4) The Humanities (fine arts, literature), and (5) Applied Arts and Sciences (agriculture, business education, home economics, and industrial arts). Each of these areas is a part of the experience leading to the complete integration of the individual into the society in which he lives.

In this reference, we find industrial arts occupying a position similar to several other areas which have as their function the development of meaning through application to the occupational and productive activities of our society. The student who is truly educated must know more than the theoretical aspects of communication, science, art, government, etc. He must build relationships among these subjects and develop a sense of their purposes. Since industrial and related activities are very important in the present age, a study of the application of art, science, economics, sociology, etc., in the engineering-planning-production sense, gives meaning to many of the other areas and provides orientation for selection and preparation of an occupation.

B. A Definition

Industrial arts is a laboratory-classroom experience designed to orient students to our technological culture. Problem solving through analysis, planning, designing, production, and evaluation is the basis for laboratory activities. Analysis of industrial occupations, cultural patterns, the nature of planning and engineering as a problem-solving technique, tool design and use, and the nature of materials, provide the basis for classroom study and field trips.

## What Objectives Should Be Emphasized?

We believe that in a total program of industrial arts education, specific objectives should be derived for the various age and grade levels of the school from the elementary grades through the adult program. The objectives would not be the same for the slow learner and the gifted. However, these specific objectives should be developed for each separate program and should be supplemental to the four major objectives which follow. These four objectives are believed to be unique to industrial arts and should be emphasized in our public school programs.

1. *To develop in each student an insight and understanding of industry and its place in our culture.*

No student can lay claim to being an educated person today unless he has some understanding of the industrial society. Industry is a dominant element in this society. It is the responsibility of the schools to help each student understand the world in which he lives. While this may be done through courses in economics, sociology, and physical sciences, these courses are often taught in such a way that the student studies about these phenomena rather than actively participating in them. Industrial arts, on the other hand, when organized to give significant learning experiences (i.e., Bick's project in city planning or Maley's on research and experimentation) enables the student to gain insights and understanding through active participation.

One of the functions of industrial arts is the development of meaning through application to the occupational and productive activities of the society. The student who is truly educated must know more than the theoretical aspects of communication, science, art, government, etc. He

**must see relationships among these subjects and develop a sense of their purposes since each area is a part of the experiences leading to his complete integration into his society.**

***2. To discover and develop talents of students in the technical fields and applied sciences.***

**One of our social responsibilities is to provide opportunities for the individual to develop to his fullest. Students in our schools represent a diversity of talents. It is the school's responsibility to help students discover and develop their talents, and it is the responsibility of industrial arts to help them discover and develop the talents in technical fields and applied sciences. The best way to discover talents is to provide experience situations in which the talents may appear. Industrial arts provides experiences in technical education which provides the opportunity for the discovery of technical abilities.**

In discussing this problem of discovering and developing unique talents, Hornbake[16] says:

> **Many of our youth will find their unique talents to be challenged by the operation of industry. They may like to work with others in producing tangible goods; they may like to work with tools and machines where the goal is to produce both quality and quantity; they may like the task of coordinating a whole host of variables—people and things—toward a common end; they may enjoy the competition which lies in the free enterprise system; they may employ the search for better ways of doing things. But these likes and dislikes are not to be found in reading, or in talking with a counselor, or in taking aptitude tests. The school shop, properly organized, can provide the most appropriate situation since the school shop is basically an education environment where individual aptitude and individual reaction supersede the importance of production.**
>
> **Industrial arts should meet the basic needs of many of our youth who will burgeon to become the future technicians, engineers, or production workers in our rapidly expanding industrial economy. As industrialization becomes more and more complex, the length of time required for preparation of intelligent participation is lengthened. This makes it necessary that greater emphasis be placed upon the development of both understandings and skills employed by those who are so occupied. To do so merely recognizes the nature of the society for which the school is an instrument and the difference in individual needs among students.**

***3. To develop technical problem-solving skills related to materials and processes.***

**Teaching industrial arts shopwork should begin with a problem approach. Man has developed tools and machines to solve his problems, to get the job done more easily and quickly. As new problems arise, new tools are designed to meet these problems. To use tools and materials in industrial arts divorced from problem solving becomes busywork. The problem-solving approach in industrial arts, when properly directed by the teacher, leads to creative thinking, the application of principles of science and mathematics, as well as technological developments.**

**If we oversimplify the total task of education and agree that the central purpose of education is to enable the student to solve all of his problems (emotional, social, communicative, vocational, etc.), we would then say that the purpose of industrial arts is to provide experiences which will enable the student to solve the technical problems of living in a highly industrialized age. The experiences provided should give the student an opportunity to apply science, mathematics, and other facets of his general education to the solution of practical problems in the industrial arts shop.**

***4. To develop in each student a measure of skill in the use of the common tools and machines.***

**Skill is essential in every industrial arts program. If used properly it becomes the tool which the student uses to achieve his goals—it leads him to insights and understanding of industry; it helps him discover and develop his talents in the technical fields; and it aids in the development of problem-solving skills. If, on the other hand, it is used improperly, the student will become its slave. It becomes an end in itself, and a program of industrial arts interested primarily in developing manipulative skills can hardly be justified except for the slow learner.**

**To be able to use the common hand and machine tools correctly, safely, and skillfully is perhaps as important to the industrial arts student as the mastery of brush techniques is to the artist, or as the skillful use of the dissecting set and microscope is to the student of biology. In each case, skills and techniques are means to ends and not ends in themselves. However, some of these skills are important enough to teach them "on purpose." Every student should be encouraged to perform every task skillfully to the best of his ability and time available. Pride in workmanship comes from a job well done.**

## A Brief Summary

**In answer to the question, "What objectives should be emphasized in industrial arts," the following four were selected:**

1. **To develop in each student an insight and understanding of industry and its place in our culture.**

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[16] **Hornbake. Op. cit., p. 15.**

2. To discover and develop talents of students in the technical fields and applied sciences.
3. To develop technical problem-solving skills related to materials and processes.
4. To develop in each student a measure of skill in the use of the common tools and machines.

While these four are considered basic for industrial arts as a whole, supplementary objectives should be developed for the various age and grade levels—elementary, junior high school, senior high school, and adult programs. Supplementary objectives should also be considered for the gifted and the slow learner.

Manipulative skills are important but only as they are used in achieving the major goals of industrial arts education.

## Discussion Highlights

Industrial arts should strive to develop insights and understanding of industry and its place in our culture, to discover and develop talent, and to develop intelligent consumers of the products of industry.

Let's take for example the objective: "to develop insights and understandings of industry and its place in our culture." Would this objective be applicable from grades 1 to 12? Or, does it have appropriateness for grades 1 through 3 and not for grades 1 through 12? There is no reason why this objective can't apply to all grade levels, but the level of difficulty taught would vary with the maturity levels of the students. For example, in the elementary grades the students should know about the occupations of many of the people in the community, and as they take trips they should raise questions. In the elementary school, industrial arts helps to bring life and meaning to social studies, science, health, etc.

As an illustration, a health unit of instruction was vitalized for prospective teachers and supervisors when the students actively participated in building a device which could improve sanitary conditions. The students who actively took part in its construction gained better understanding of health problems. There seems to be an upsurge of interest in industrial arts for the elementary school.

It is the school's responsibility to help students discover and develop talent. Industrial arts helps discover those students who desire to be a part of industry—as engineers, technicians, and production workers. The best way to discover talent is to provide experienced teachers and the setting which will allow this talent to emerge and develop.

The objective of "developing technical problem-solving skills related to materials and processes" has a broad concept, and it certainly relates to what was discussed earlier at this conference. We need to promote and develop this idea.

Perhaps we should put the emphasis on "practical problem-solving skills" since it seems to apply to this area of instruction rather than to others.

One of the difficulties in teaching problem-solving is the method used in bringing it about. If the wrong approach is used, desired results will not be obtained. It must be accomplished through analyzing, planning, designing, producing, and evaluating.

Teachers of industrial arts should use the problem-solving approach to teaching. They should begin with a problem and use tools, materials, and machines, etc., for solving the problem. A measure of skill is important because through it the student realizes his goals. It leads him to insight and discovery of himself and his ability.

Is the concept of consumer knowledge, as generally conceived by industrial arts teachers, included within the four objectives as stated? The objective of consumer knowledge is not unique to industrial arts, but it is implied and has a definite place. Safety consciousness and work attitudes and habits are also part and parcel of the objective dealing with the development of technical problem-solving skills related to materials and processes.

The recreation objective really belongs at the adult level rather than at the lower school levels. However, there is no reason why a good program could not be developed for youth and adults.

It must be remembered that the four objectives presented would apply to all levels of instruction but that the concepts should vary with the grade levels. For example, the objective of developing technical problem-solving skills related to materials and processes would be likely to attract students who are interested in invention and those who are of the type who participate in national science fairs. This whole idea of developing technical problem-solving skills would shift emphasis away from a "canned type curriculum" which does not stimulate the imagination of ingenuity of the youngster to do creative work.

There has been more agreement in the profession on the aims or objectives of industrial arts than on the implementation of the program. These four objectives are the basic ones and if one wishes to add more they should be related to the four.

We have had too many objectives in the past. This causes so much confusion that it is difficult to understand what they all mean.

Over the years we have had 25 different objectives, then they were reduced to around 12, now we find these overlapping. Of course, you would have over-

**lapping if you had ony three or four objectives to some degree. Some objectives are more important than others, and we have found greater success by having fewer objectives for our industrial arts curriculum area.**

**Recent research in progress at the Office of Education, although not completed, deals with industrial arts objectives reported in State curriculum guides. The guides indicate that the first five objectives listed for all grade levels are: (1) interest in industry, (2) appreciation and use, (3) shop skills and knowledge, (4) health and safety, and (5) creativity and self-expression. The emphasis on the different objectives varies at each grade level.**

# What Guidelines Should Be Followed in Determining Curriculum Content for Industrial Arts?

*by*

***Delmar W. Olson***

GUIDES DETERMINE directions. For industrial arts curriculum development there are two choices of guides: we can choose those which look backward or those which look ahead. If we are to find our way out of our present dilemma, it appears that we had better discard the guides we have been using for half a century. The old ones have been leading us in circles and as a result, we now have essentially the same curriculum with which we started. It is imperative that industrial arts follow a new set of guides if it will make any significant contributions to American education in the years ahead.

The outline study which follows is a proposal in bare, structural form based on a new direction for industrial arts. The new direction is the technology. The outline sets up scores of guides for proceeding with curriculum development based on the technology.

Part I lays the background for the "new" industrial arts with a guiding interpretation and then with a picture of industrial arts in its many areas of service.

Part II includes a listing of guides drawn from a consideration of the functions of industrial arts, from an interpretation of the technology, and from an analysis of the human postulate. In part III a description of the new project for the new industrial arts gives greater status and dignity to the project. It proposes a series of measures as guides for the new project.

Finally, in part IV a proposed industrial arts curriculum for the public school shows how a study of the technology in industrial arts can be fitted to the 12 grades. This curriculum demonstrates a completeness, a unity, and a continuity which has not been characteristic of industrial arts in the past. It suggests the possibility of an organized, fully functional program of industrial arts of the type that young Americans need if they will understand America and know themselves.

## Part I. A Concept of Industrial Arts

**A. Industrial Arts: A Guiding Interpretation**

**Industrial arts is a study of the technology, its origins and development; its technical, consumer, occupational, recreational, social, and cultural nature; and its influences through experimenting, creating, designing, inventing, constructing, and operating with industrial materials, processes, and products. Its purposes are to acquaint the student with his technological environment and to aid him in the discovery and development of his own human potential.**

**B. Industrial Arts: Facets of the Whole**

- **1. Industrial Arts Education**
  - **(a) The elementary school**
  - **(b) The junior high school**
  - **(c) The senior high school**
  - **(d) The college and university**
- **2. Industrial Arts Recreation**
  - **(a) School recreation**
  - **(b) Community recreation**
  - **(c) Private agency recreation**
- **3. Industrial Arts for Special Students**
  - **(a) The gifted student**
  - **(b) The retarded student**
- **4. Industrial Arts Therapy**
  - **(a) Therapy**
  - **(b) Rehabilitation**
- **5. Industrial Arts Teacher Education**
  - **(a) The school level**
  - **(b) The collegiate level**
- **6. Industrial Arts and the Institute of Technology**
  - **(a) Teacher education**
  - **(b) Terminal programs**
- **7. Industrial Arts as Liberal Arts**
  - **(a) Recreational aspects**
  - **(b) College-preparatory level**
  - **(c) Collegiate level**

**8. Industrial Arts for Adults**
   - **(a) Technical terminal programs**
   - **(b) The do-it-yourself movement**

**9. Industrial Arts and Developing Countries**
   - **(a) General education nature**
   - **(b) Economic functions**
   - **(c) Terminal nature**
   - **(d) Preparation for industrialization**

## Part II. A Derivation of Guides

**A. Basic Sources of Guides for the Industrial Arts Curriculum**
   - **1. The functions of industrial arts**
   - **2. The technology**
   - **3. The human postulate**

**B. The Functions of Industrial Arts as Guides**

**1. The Technical Function**
   - **(a) How industry discovers, mines, refines, and manufactures materials**
   - **(b) How industry employs technical processes and scientific principles to convert materials into products**
   - **(c) How industry designs, produces, uses, and services machines**
   - **(d) How industry provides housing for industry, business, government, schools, homes, etc.**
   - **(e) How industry provides transportation for materials, products, and people**
   - **(f) How industry produces, transmits, and utilizes power**
   - **(g) How industry provides, operates, and services communications media and systems**
   - **(h) How industry employs research in the development of materials, processes, products, and industries**
   - **(i) How industry employs organization, management, personnel, records, and controls in the production of goods and services**
   - **(j) How industrial products are used, operated, maintained, and serviced in industry, business, home, school, etc.**
   - **(k) How the student can convert materials into products and projects by means of representative processes with machines and tools**
   - **(l) How the student can employ materials, processes, and products in the development of ideas and in the solution of problems**

**2. The *Consumer* Function**
   - **(a) Individual interests and needs as measures of selection**
   - **(b) Social concern as measure of selection**
   - **(c) Qualitative standards as measures of selection**
   - **(d) Operation, care, and maintenance as elements of utilization**
   - **(e) Appraisal of economic, personal, social, functional, and esthetic values**

**3. The *Occupational* Function**
   - **(a) The jobs that industry provides**
   - **(b) How people earn their livings in industry**
   - **(c) The changing nature of the job**
   - **(d) Educational requirements and opportunities**
   - **(e) Qualifications, rewards, and hazards**
   - **(f) Measures of successful work experience**

**4. The *Social* Function**
   - **(a) Personality development**
   - **(b) Development of social competencies**
   - **(c) The individual and society**
   - **(d) The individual and industry**

**5. The *Recreational* Function**
   - **(a) Recreation as "re-creation"**
   - **(b) Recreation through work**
   - **(c) Leisure for learning; learning for leisure**
   - **(d) Recreation for self-expression, liberation**
   - **(e) Recreation and personal growth, achievement, enrichment**
   - **(f) Recreation and rehabilitation**

**6. The *Cultural* Function**
   - **(a) The cultural function as the study of the material culture**
   - **(b) The material culture as a record of the material progress and the cultural level of a people**
   - **(c) The material culture as the relationships of materials, tools, machines, science, and invention, in a technological society**
   - **(d) The material culture as the record of material achievements in the industries and crafts**
   - **(e) The material culture as the record of great men: industrialists, craftsmen, scientists, inventors, designers**
   - **(f) The material culture as the record of materials and techniques: primitive, modern**
   - **(g) The material culture as the record of man's utilization of his human potential in an environment of materials**
   - **(h) The material culture as the power of the technology**
   - **(i) Technology as the primary resource**
   - **(j) Technology as influencing human growth and development**
   - **(k) The spirit of today's technology**
   - **(l) The concern for materialism versus humanism**

**C. The Technology as a Source of Guides**

**1. The nature of the Technology**
   - **(a) Technology as the means for the creation of man's physical environment**

        - (b) Technology as man's control of his physical environment
        - (c) Technology as man's control of nature
        - (d) Technology as the material culture
        - (e) Technology as the primary resource
        - (f) Technology as the great civilizer
        - (g) Technology as the great liberator
        - (h) Technology as the great provider
        - (i) Technology as the creator of wealth
        - (j) Technology as the great benefactor
    - 2. Typical Elements of the Technology as Guides and as Subject Matter
        - Automation
        - Circuits
        - Communications
        - Construction
        - Design
        - Development
        - Engineering
        - Esthetics
        - Evaluation
        - Experiment
        - Invention
        - Machines
        - Materials
        - Mechanisms
        - Operation
        - Planning
        - Power
        - Processes
        - Production
        - Products
        - Recreation
        - Refinement
        - Research
        - Safety
        - Services
        - Standards
        - Structures
        - Study
        - Supervision
        - Systems
        - Techniques
        - Tools
        - Transportation
        - Work
- D. The Human Postulate as a Source of Guides
    - 1. The Concern for Self
        - (a) The discovery of potential
        - (b) The development of potential
        - (c) The expression of self
    - 2. The Concern for Intellectualization
        - (a) The potential of learning
        - (b) Knowledge
        - (c) Understanding
        - (d) Appreciation
    - 3. The Concern for Creating
        - (a) Origination: finding the new, the better
        - (b) Imagination: conceiving in the abstract
        - (c) Invention: expressing in the concrete
    - 4. The Concern for Ideation
        - (a) Ideas as solutions to problems
        - (b) The processes in ideation
        - (c) The sources of ideas
        - (d) The testing of ideas
        - (e) The search for a better idea
    - 5. The Concern for Constructing
        - (a) The facility for controls and adjustment
        - (b) The facility for operation
        - (c) The facility for assembly
        - (d) The facility for problem solving and planning
    - 6. The Concern for Socialization
        - (a) Communications with others
        - (b) Personality development
        - (c) Social competence
        - (d) Leadership, followership

## Part III. Measures of the Project in the New Industrial Arts as Guides to Curriculum Development

Industrial Arts throughout its evolvement has been known for the project. With the coming of technology as the new curriculum for industrial arts, the project takes on increasing significance. The project accepted for the new curriculum will be a measure of our understanding of the technology. The problem is to conceive of the project as truly reflective of the technology. In such a project the human and his creative and constructive powers come into focus. The new project then becomes an expression of the involvement of the student and the technology. The following outline pictures the new project in its three dimensions: the technology, the human, and the professional or industrial arts.

- A. The Project as Reflective of the Technology
    - 1. The Materials
        - (a) The project as an integration of materials
        - (b) The project as effective utilization of materials
        - (c) The project as a best choice of materials
        - (d) The project as proper materials in effective structural relationships
        - (e) The project as materials enhancement
    - 2. The Processes
        - (a) The project as an application of technical processes
        - (b) The project is an application of engineering practices and scientific principles
        - (c) The project as a resultant of the design process
        - (d) The project as the best choice of processes and structures
        - (e) The project as a product of machine processing
    - 3. The Quality Standards
        - (a) The project as an example of the pursuit of technical excellence
        - (b) The project as technically respectable
        - (c) The project as a demonstration of functional efficiency
        - (d) The project as an example of material control
        - (e) The project as employment of a measured durability, as permanence vs. obsolescence
    - 4. The Economics
        - (a) The project as an example of good judgment in economics
        - (b) The project as value added to materials

(c) The project as economical of time
(d) The project as regard for the conservation of materials, natural resources
(e) The project as an example of labor saving

B. The Project as Reflective of the Human
1. Human Resources
(a) The project as experience in creative imagining
(b) The project as experience in problem solving
(c) The project as a drawing out of talents
(d) The project as an example of a better idea
(e) The project as a demonstration of creative constructing

2. Human Responsibility
(a) The project as acceptance of responsibility for effective planning
(b) The project as requiring personal initiative, resourcefulness
(c) The project as acceptance of responsibility for development of capacities
(d) The project as a means for sharing ideas
(e) The project as acceptance of responsibility in an environment of freedoms

3. Human Potential
(a) The project as a projection of personality
(b) The project as a free expression of individuality
(c) The project as an incentive to greater achievement
(d) The project as re-creative experience
(e) The project as a means to human growth and development

C. The Project as Reflective of Industrial Arts—The Professional Dimension
1. The Technology
(a) The project as essential to understanding the technology
(b) The project as representative of occupational fields
(c) The project as a materials expression
(d) The project as evidence of intelligence at work
(e) The project as technically respectable

2. The Student
(a) The project as an achievement
(b) The project as real and meaningful experience
(c) The project as student-consuming
(d) The project as a solution with emphasis on individuality, uniqueness
(e) The project as expression of self

3. The Profession
(a) The project as educationally respectable
(b) The project as evidence of professional maturity
(c) The project as achievement of objectives
(d) The project as both means and end
(e) The project as culturally significant

## Part IV. The Proposed Industrial Arts Curriculum for Today's Schools

I. The Elementary School

| | |
|---|---|
| Grades 1, 2 | Technology and the Community |
| Grades 3, 4 | Technology and the Nation |
| Grades 5, 6 | Technology and the World |

II. The Junior High School

| | |
|---|---|
| Grade 7 | The Manufacturing Industries: Leather, plastics, ceramics, chemicals, foods |
| Grade 8 | The Manufacturing Industries: Graphic arts, paper, textiles, rubber |
| Grade 9 | The Manufacturing Industries: Woods, metals, tools, machines |

III. The Senior High School

| | |
|---|---|
| Grade 10 | The Construction Industries<br>The Electronic Industries |
| Grade 11 | The Power Industries<br>The Transportation Industries |
| Grade 12 | The Services Industries<br>Industrial Management |
| Grades 10, 11, 12 | Research and Development |
| Grades 10, 11, 12 | Industrial Arts Recreation |

## Discussion Highlights

The first guidelines to be followed in determining curriculum content are logically those inherent in a basic concept of industrial arts. It is one thing to propose a series of guidelines, another to justify them. The working paper presents in outline form, as a first step, a proposal for a new direction for industrial arts. The new direction is the technology. Industrial arts is considered here as a study of the technology.

The complete picture of industrial arts includes its programs for the elementary school and the junior and senior high schools; its offerings as recreation and therapy; its place in the university and the technical institute; as well as teacher education.

There have been some reservations in accepting recreation as a valid function for industrial arts. However, if one accepts technology as the subject matter, then one must also accept recreation. It is because of technology that we have leisure. Technology not only provides us with leisure, but it also provides us with the means for making use of that leisure.

When the term "function" is used with reference to the working paper, it refers to the mission of industrial arts and serves as a source of specific objectives.

When an American claims he is "cultured" because he knows the fine arts—and only the fine arts—he is deluding himself. Our culture is definitely a material one. Today industry is operating on the philosophy that whatever man can conceive, industry can do. That is a truly dynamic concept. We, in industrial arts, must help youngsters to see the meaning and value in this emphasis if they will understand the culture of which they are a part.

Technology, as a source of guides, becomes a great human resource in man's control of his environment and destiny. It has become a great liberator for the American people; other countries look to technology to become their great liberator, too.

A basic responsibility which industrial arts teachers have is to assist students in the discovery of their own potential for creative imagining, manipulating, constructing, problem solving, and reasoning.

The proposed industrial arts program for the public school is not the only possible arrangement for the subject matter. It is divided into three levels with the same fundamental objective: to enable youngsters to understand the culture of which they are a part. Beginning at the elementary school, with the influence of technology in their homes and community, the students will see industry and people at work; they will study materials, products, and processes which have their origin in the technology. As the student progresses in the elementary school he expands his horizons and sees technology as it affects the Nation and the world.

The junior high school level becomes an area of study centered in the manufacturing industries. The senior high school (grades 10, 11, 12) gives opportunity for concentrated study. At this grade level, opportunity should be available for industrial research and development experience.

The guides proposed in the working paper are useful insofar as one believes that technology should be the subject matter for industrial arts. But if one does not agree, there will be few guides useful for curriculum construction in industrial arts as we now know it.

Industrial arts has something to offer at the elementary grade levels. It should not be used merely to help the elementary teacher do better what she ought to do anyway. With the emphasis on foreign language and other courses in the elementary schools, it will not be difficult to make additions to the curriculum.

In the junior high school, the requirements in science and mathematics are increasing. How can the student do all the things suggested in industrial arts? The concern is not so much with current problems now, but to identify those things that boys and girls need in order to live intelligently in America. When we can answer this in terms of the industrial arts curriculum area, then we will find industrial arts fully as much justified for inclusion in general education for all because it is fundamental, along with mathematics, science, foreign language, etc.

The problem of teaching about technology, since it has "literally exploded in content" in recent years, calls for industrial arts curriculum reorganization from grades 1 to 12. More time should be allocated for this in the elementary school as well as at other levels, including the adult level. We need to encourage teachers and schools to experiment and to explore more with different kinds of programs.

There is enough content in elementary industrial arts to enable it to stand on its own; nevertheless, it really has two functions: (1) stimulating and enriching other curriculum areas such as social studies and science and (2) presenting content specifically relating to the industrial arts. A combination of the two functions needs to be accomplished.

What about the research and development program at the junior high school level? How can it be implemented? There is an experimental program underway in two schools, for example, which has been carried on for 2 years. The program is elective, and next year's classes are already full and there is a waiting list. The course is called a research and development laboratory. In the beginning, the concept of this research and development idea was to have it a part of every class and meeting the needs of certain students. However, this course is for only a certain group of students—just like those students in advanced classes in mathematics, science, or pre-engineering programs for the gifted. The students who take this course for an elective have a good background in mathematics and science. They get an insight into industry and understand better why industry spends $12 billion on research and development. This kind of course does much to help build up the professional aspirations of students who wish to become scientists and engineers. What we have tried to do in this experimental program is to develop a course to meet the needs of this particular group of students.

No doubt, there are possibilities in advanced electronics, advanced metal work, etc. It is felt that in the high school the research and development-type course is for a selected type of student—not for everyone. Of course, there should be some research and development going on in all courses commensurate with the maturity level of the students.

It should be stressed that the guidelines offered in the working paper, if used, will move industrial arts toward technology and will be useful to the extent to which we believe that this is the right direction for industrial arts to move. For example, the "measures of the project in the new industrial arts as guides to curriculum development," reflect not only the technology, but the human and professional dimensions as well.

The guiding interpretation presented in the working paper reenforces the discussion concerning the place of industrial arts in the American culture and the objectives mentioned in the previous sessions. The guiding interpretation states that one of the purposes of industrial arts is to acquaint the student with his technological environment and to aid him in the discovery and development of his own human potential.

One way in which the curriculum guides can be used is to test content for selection in the program using the guidelines as criteria. If the content measures up to the guidelines, then it would be satisfactory material for study in industrial arts. For example, there are 12 guidelines under the *technical function*. Content satisfactory for industrial arts must meet the criteria stated in one or more of these guides. "The study of the manufacture of copper ore" would then be a satisfactory topic for discussion. Likewise, the production of electrical energy from coal, oil, or atomic materials would also be satisfactory. These topics would be satisfactory because they meet the criteria set forth in these guidelines. The same procedure in judging the selection of the project, if it meets the criteria set by the guidelines, would be satisfactory. If the topic or project did not meet these guidelines, then it should be rejected as not being satisfactory for instruction in industrial arts.

# What Implications Are There in Soviet Polytechnic Education for Industrial Arts?

*by*

***Marshall L. Schmitt***

DURING THE SPRING of 1959, I was privileged to be a member of a three-man study team, from the U.S. Office of Education, to observe education in the general schools of the Soviet Union. Our team stayed in the Soviet Union about 1 month and observed 14 schools, 8 teacher-training schools, and 6 pedagogical institutes.

One of the purposes of the observation trip was to learn firsthand about Soviet polytechnic education—the technological education taught in the general schools—and, as a result of the trip, to sort out from the many impressions and information gained ideas that could be used to improve education in the United States.

## Historical Perspective

History books have already documented the fact that before the turn of the 20th century the Russian system of workshop instruction had influenced early forerunners of the present programs of industrial arts. For example, an exhibit of the systematic teaching analysis of tool processes and construction methods, developed by Victor Della Vos, Director, Imperial Technical School (1868), Moscow, was first displayed in this country in Philadelphia in 1876. Bennett[1] reports that:

> A direct result of its presentation in Philadelphia was the opening of the School of Mechanic Arts in connection with the Massachusetts Institute of Technology in Boston and the adoption of the principles of the system by the St. Louis Manual Training School of Washington University. These schools gave it (Russian system of workshop instruction) an impulse which spread over the United States, resulting in the movement to establish manual-training high schools, and even echoed back over the ocean to England.

The last 75 to 80 years have seen many changes in workshop (nonvocational technical work) instruction given in the public schools of the United States, beginning with manual training, then manual arts, and culminating in the curriculum area now referred to as the industrial arts. The industrial arts, a workshop and/or laboratory-type program dealing in various phases of the technical side of American society, is conceived as general education—essential for all students living in a highly industrialized society which depends on technology for advances in its material culture.

## Present-Day Influences

The present interest in Soviet education by Amercan educators can be identified as stemming from the dramatic launching of "Sputnik" in 1957. Since that time, much more has been said and written than in earlier years about Soviet education and the subsequent reactions in programs in mathematics, science, and foreign languages in the public schools of the United States.

On the other hand, little has been said and written about the "practical arts" aspect of Soviet general education at the elementary and secondary level.

This report reveals that Soviet educators feel that their practical arts courses are vital to Soviet pupils; as vital as mathematics, science, foreign language, etc. These practical arts or *polytechnic* courses, as they are called in Soviet terminology, are required of all students as a part of their general education. A glance at table 1 shows the extent these courses are required in the 10-year general education schools. The selected polytechnic courses were a part of the total curriculum of 25 percent of the schools in the Russian Soviet Federated Socialist Republic in (RSFSR) in 1957–58. During the school year 1958–59, 50 percent of the schools were on this plan.

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[1] Charles A. Bennett, *History of Manual and Industrial Education, 1870 to 1917*. Peoria, Ill., The Manual Arts Press, 1937. p. 42.

## Comparison of Polytechnic and Industrial Arts Education

In order to acquire a general understanding of Soviet polytechnic education, the following description of selected characteristics of polytechnic education in the 10-year general school is compared with industrial arts in the United States. The comparisons are made in definition, relation to other studies, titles of courses, curriculum, production work, teacher, methods of teaching, organization and operation of courses, equipment and facilities, and research. This comparison shows only some of the similarities and differences in the two programs. At best, it is only a rough comparison because of the complex nature of both educational programs and the difference in aims of the two societies.

*Table 1.—Selected Polytechnic Courses* [1]

| Study Plan | Hours of instruction per week in grade— | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 10-year school, 1958–59: | | | | | | | | | | |
| Drawing | 1 | 1 | 1 | 1 | 1 | 1 | -- | -- | -- | -- |
| Technical drawing | -- | -- | -- | -- | -- | -- | 1 | 1 | 1 | 1 |
| Practical work (labor training) | 1 | 1 | 2 | 2 | 2 | 2 | 2 | -- | -- | -- |
| Principles of production | -- | -- | -- | -- | -- | -- | -- | 3 | 4 | 4 |
| **1958–59 total** | **2** | **2** | **3** | **3** | **3** | **3** | **3** | **4** | **5** | **5** |

[1] Main Administration of Schools, Russian Soviet Federated Socialist Republic, ministry of Education. Study plan of elementary, 7-year, and secondary schools for experimentation in the 1957–58 school year (in Russian). Looseleaf. Moscow, 1957. p. 2

(1) In grades 5, 6, and 7, 22 hours are spent in each grade on fall and spring work in the school plot (garden).

(2) Besides the practical exercises and educationally productive practice carried out in grades 5–7 and in grades 8–10 during the school year, there should be provided:

(a) Educationally productive practice in urban schools—on the school plot at the time of transition from grade 5 to grade 6—6 work days (3 hours a day), and at the time of transition from grade 6 to grade 7, 6 workdays, at the rate of 3 hours a day. In rural schools, 12 workdays (3 hours a day) on the school plot on a collective farm during the change from grade 5 to 6; and 12 workdays, at the rate of 3 hours a day, during the change from grade 6 to 7.

(b) Educationally productive practice in agriculture at the time of transition from grade 8 to 9, for urban and rural pupils, for 24 days at the rate of 4 hours a day.

(c) Educationally productive practice in agriculture at the time of transition from grade 9 to 10, for pupils of rural schools, for 24 days (4 hours a day); and in industrial enterprises, for urban pupils, for 29 days at the rate of 4 hours a day.

(3) To each 10th grade pupil there will be assigned 10 hours for learning practical driving in an automobile (tractor).

## *Characteristics of Soviet Polytechnic Education in the 10-Year General School Compared With American Industrial Arts Education*

| Polytechnic Education | Industrial Arts |
|---|---|
| DEFINITION | |
| Polytechnic education deals with understanding the various technics of industrial and agricultural production; the application of scientific principles to mass production; the organization and utilization of workers; the development of habits of work and technical abilities; and the planning of jobs involving self-discipline and initiative. | The industrial arts is a curriculum area in the public schools which provides the setting for pupils to learn about industry—the user of science—and to experience the act of creating from materials, new and different forms which have human value. In so doing, students are able to understand and be sensitive to materials, processes, operations, machines, tools, mass production, opportunity for work, quality of products and services, maintenance, safety, and the significance of technology and its effect on society and on the individuals within that society. |

| Polytechnic Education | Industrial Arts |
|---|---|
| **RELATION TO OTHER STUDIES** | |
| 1. Closely related to science and mathematics and all other subjects. | 1. Sometimes correlated with physical science and other subjects. No major effort to correlate except in recent years. |
| 2. School garden plots and workshops serve as practical laboratory testing areas for applied science and technology. | 2. No garden plots but workshops sometimes serve as practical laboratory testing areas for applied science and technology. |
| 3. Closely related to drawing. Very little planning by students themselves. No individual plan sheets. | 3. Closely related to drawing. Much individual planning by students and use of separate plan and procedure sheet. |
| **TITLES OF COURSES** | |
| 1. Drawing (grades 1–6) required. | 1. Art experiences (grades 1–8), of which drawing is a part, are a requirement of the elementary school program. |
| 2. Technical drawing (grades 7–12) required. | 2. Mechanical drawing (drafting) (grades 7–12), not required. |
| 3. Labor training (grades 1–7), handicraft work in lower grades; upper grades have subject-matter courses like locksmithing (metalwork) and joinery work (woodworking) required. | 3. Construction activities and handicraft work, or elementary industrial arts (grades 1–6), not required. |
| 4. Fundamentals of production (grades 8–10), industrial and agricultural courses like machine study, fundamentals of plant breeding, and industrial production required (including No. 7 and No. 8). | 4. Industrial arts, general shop, or individual subject-matter courses like general metalwork, general woodwork, electricity, etc. (grades 7 and 8) usually required for boys only. |
| 5. Production training in specific enterprise, observation and actual work in industry in ninth grade, 10-year school plan; also fall and spring work on garden plots. Summer practice between grades. Variety of industries used within any geographic area. | 5. No planned industrial arts work experience in industry or agriculture; only observation trips.<br>NOTE: Some schools have work-experience education programs either for general education or vocational purposes. Industrial Arts teachers, with special training, sometimes act as coordinators of the program. |
| 6. Senior grades: no comparable shops or laboratories, except as noted in No. 7 and No. 8. | 6. Senior grades: industrial arts, general shop, craft, general woodwork, general metalwork, graphic arts, etc. |
| 7. Electrotechnics. | 7. General electricity and electronics. |
| 8. Automobiles (city schools) and tractors (rural schools). | 8. Automechanics, transportation, or power mechanics. |

| Polytechnic Education | Industrial Arts |
|---|---|
| **CURRICULUM** | |
| 1. Curriculum planned at Ministry of Education. Program is same in all schools and obligatory. | 1. Curriculum planned by State and local school systems. Varies from city to city and State to State. |
| 2. Identical textbooks in grades 8–10. Grades 5–7 do not now have textbooks, only teacher's guide. (Future plans, however, are to include textbooks for pupils.) | 2. Textbooks vary according to school or State authorities. Texts for pupils in grades 7–12. |
| 3. Work experience in one or several industries in area, such as (city schools) machine-building plants; textile industry, building construction, electrical, etc. (232 hours in ninth grade). In rural schools, work experience is conducted on farms. | 3. No planned work experience. |
| 4. Girls and boys take same courses. | 4. Boys take industrial arts, while girls take homemaking. |
| 5. Individual and group projects—emphasis on group making same project. | 5. Individual and group projects—emphasis on individuals making different projects. |
| **PRODUCTION WORK** | |
| 1. Considerable amount of actual production work done in class and after school. | 1. Little actual production work done in class. None after school. |
| 2. Pupils and schools receive remuneration for work done on production work in class, after school, and during summer practice. | 2. No remuneration given. No work experience required. Schools do not receive remuneration from students' work. |
| 3. Production work coordinated closely with economy and factories in the school area. Also production for school's use. | 3. Production work done by pupils in limited quantities for school's or pupils' use—purpose is to learn about mass production principles and problems and not to develop production skills for job occupation. |
| 4. Students work extensively on school grounds to improve them. | 4. Very little student work on school grounds. |
| **TEACHER** | |
| 1. Trained in 5-year pedagogical institute, or from the ranks of industry, plus inservice courses. | 1. Minimum of 4-year baccalaureate degree. Many have master's; some, doctor's. |
| 2. Assistant teachers used extensively. Assistants have industrial backgrounds and inservice pedagogical training. No degree. | 2. Generally no assistants or teaching aide. |

| Polytechnic Education | Industrial Arts |
|---|---|
| **METHODS OF TEACHING** | |
| 1. Lectures, visual aids (all types, especially charts), demonstrations, group and individual instruction. Much emphasis on individual instruction. | 1. Same. Not quite as much individual instruction. Not so formalized. |
| 2. Very little student planning but some coordinated with drawing classes. | 2. Much student planning. Some coordination with drawing classes. |
| 3. Use of experiments in electrotechnics course. | 3. Same, but more actual project work. |
| 4. Use project method but usually follow a model. | 4. Use project method with much student planning, but sometimes follow models. |
| 5. Technical drawing classes work primarily from wooden models (simple to complex). Also, have problems selected from text. Mostly machine-type drawing. | 5. Very little use of models. Problems selected from texts. Includes machine, architectural, sheet metal, electrical drawing. |
| 6. Use teaching assistants. | 6. Do not use teaching assistants. |
| 7. Students clean up shop—select one leader in group at beginning of semester; simple organizational plan. | 7. Personnel organization usually patterned after industry; elaborate organizational plan. |
| 8. Students are required to make penciled sketches of article to be made, from the teacher's drawing on the blackboard. Procedure also discussed. | 8. Similar, but plan sheet used with procedure and cost determined primarily by student. |
| 9. Teachers follow detailed prescribed course of study from Ministry of Education. All students make the same article. | 9. State and/or local course of study used. Students sometimes make the same project; more often students make different articles involving similar operations and processes. Individual planning encouraged. |
| 10. Reference books located in library and in shops. | 10. Same, although much more emphasis on reference books, student textbooks, and facilities for reading. |
| 11. Homework assignments not generally given in grades 5–7. | 11. Same, but upper grades often have considerable homework assigments. |
| 12. Same teacher gives both theoretical and practical work. Although assistants are used for practical work also. | 12. Same, but with no teaching assistants. |
| 13. Written tests (control work) begin in eighth grade. | 13. Tests given at whatever grade is taught as separate subject: for example, 7–12. |
| 14. Conscious effort made to correlate workshop courses with science and other courses. | 14. Only in recent years has there been much conscious effort to correlate work in industrial arts with science and other courses. |
| **ORGANIZATION AND OPERATION OF COURSES** | |
| 1. When classes meet 2 or 3 hours per week, the hours are coupled together. | 1. Classes usually coupled together when period is 45 minutes or less; otherwise, meet singularly. Double periods are common in senior high schools. |
| 2. Length of single class period: 45 minutes. | 2. Length of single class period: 45–55 minutes. |
| 3. Work experience (10-year schools) 4 hours per week coupled together. Students work at various places in the factories and on farms. Have coordinating groups in the industry and school. | 3. None. |
| 4. No student fees. | 4. Nominal student fees. Student usually pays for individual project. |
| 5. Rotate students from shop to shop or activity to activity to get desired experience (for example, ½ year in woodwork, ½ year in metalwork). | 5. Same. |

| **Polytechnic Education** | **Industrial Arts** |
|---|---|
| **EQUIPMENT AND FACILITIES** | |
| **1. Equipment and facilities vary from school to school, however, efforts are made to provied the necessary facilities to carry out the compulsory curriculum.** | **1. Equipment and facilities vary in the different States and local school systems; however there are many common elements.** |
| **2. Patron factory for each school. Used equipment is given to school free. Sometimes some of the proceeds from student production work is used for school equipment.** | **2. New equipment purchased by State and/or local funds.** |
| **3. Separate building and/or special shop within the schools. Lower grades use regular classroom.** | **3. Separate buildings and/or special shop within the schools. Lower grades use regular classroom but sometimes have separate room.** |
| **4. Use of factory or farm equipment in work experience.** | **4. Generally, none used; but sometimes borrowed from or given by industrial groups. Surplus equipment purchased at nominal cost.** |
| **5. Pupils do not pay for materials. Can take individual articles home.** | **5. Pupils generally pay for material they use (nominal cost).** |
| **6. Students help repair machinery and construct items of equipment for workshops.** | **6. Same, but not so extensive.** |
| **7. Ordinary handtools, garden equipment, and supplies are used in elementary grades.** | **7. Same, but no garden equipment.** |
| **8. Woodshop typical: 20 single-place wood benches with 2 wood vises; 3 wood lathes, full size; 5-inch jointer; handtools; drill press; 7-inch circular saw; closets; storage room for supplies (meager); various handtool sets for each student.** | **8. General woodworking: 4 to 6 four-station woodworking benches with 4 metal vises; 8-inch jointer; 10-inch circular saw; disk and spindle sander; 4 wood lathes; finishing room; storage rooms for supplies (adequate); surfacer; jigsaw; bandsaw; planning and office facilities. Various handtools, but not enough for each student to have his own set.** |
| **9. Workshop designed for 20–25 pupils (approximately 19 x 33 feet), 627 square feet. Sometimes separate classroom for theoretical instruction.** | **9. Workshop designed for 20-25 pupils (approximately 40 x 60 feet not including storage facilities), 2,400 square feet. Sometimes separate classroom for related (theoretical) instruction.** |
| **10. Metalworking shop (mechanic's shop or locksmith's shop): 20 metal vises on benches; drill press; small heat-treatment furnace: grinder; hot plate; soldering irons; arbor press; small handtools for cutting and filing metal, and sometimes a metal lathe; arbor; storage facilities.** | **10. Activities considered a part of general metalshop. See No. 11.** |
| **11. Machine study shop: 4 metal lathes, 10-inch swing, 4-foot beds; small metal lathe; milling machine; grinder; shaper; vertical milling machine; drilling machine; benches; furnace; teacher's desk.** | **11. General metalshop: 6 four-station benches; shear; drill press; shaper; 4 lathes; arbor press; spinning lathes; welder; sheet metal machines; brake; forge; foundry; anvil; finishing room; planning and office room.** |
| **RESEARCH** | |
| **Great efforts are currently underway to find ways and means to make a better connection between school and life. Considerable research on role of labor, attitude toward work and fellow workers and the development of technical abilities in the process of schooling.** | **No major directed effort but considerable amount of research on various aspects of total program.** |

The comparison of the characteristics of Soviet polytechnic education in their 10-year general school with American industrial arts shows some similarities, but also some major differences. It should not be assumed that this comparison implies that industrial arts is the same as polytechnic education—far from it—because the aims and the methods to achieve these aims of the total educational systems of the two countries are different. The comparison, however, does indicate that both educational systems are concerned about pupils' having the opportunity to understand about the "arts of industry," and technology is an important aspect of the culture of both Nations. Polytechnic education, in the Soviet sense, is not a subject, but more a *type* of education, to which other subjects contribute.

## New Educational Reforms

Characteristics of the two educational programs not only provide an overview of the systems, but also serve as a point of reference to understand better the new Soviet educational reforms. These reforms currently underway call for even more emphasis on polytechnic education. The excerpt given in table 2 shows this emphasis. (Compare with table 1.) The first five grades were to be on the new plan during the 1959–60 school year, and each year other grades will be using the curriculum. It is the Soviet Ministry's plan that by the beginning of the school year 1965–66 all general education schools will be on the new program. Some of the major changes that can be identified now are as follows:

1. Compulsory 8 years of elementary education.
2. Optional study in grades 9, 10, and 11.
3. Complete elementary and secondary education would include grades 1–11.
4. Combination of academic work with more practical work—one of the main purposes of the reforms is to make school more closely connected with Soviet life and needs.
5. Program will have a dual purpose: (*a*) providing academic education for the university and specialized schools and (*b*) developing qualified workers in either industry or agriculture.
6. Program will include approximately 1,000 hours of vocational training.
7. Girls will take domestic science instead of woodworking courses in the lower grades.
8. Much longer period of work experience, from 6 to 18 hours per week (grades 9, 10, and 11).
9. Former academic load in grade 10 will be reoriented so that approximately one-half of the academic load is taught in grade 10 and one-half in grade 11.

*Table 2. Selected Polytechnic Courses from Study Plan of 8-Year and Secondary School (Urban) with Production Training*[1]

| Course | Hours of instruction per week in grade— | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Drawing | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -- | -- | -- | -- |
| Technical drawing | -- | -- | -- | -- | -- | -- | 1 | 1 | 2 | -- | -- |
| Labor instruction | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | -- | -- | -- |
| Socially useful work | -- | -- | 2 | 2 | 2 | 2 | 2 | 2 | -- | -- | -- |
| Socially productive practice (2 weeks each at end of the school semester, grades 5–8) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| General technical subjects, production (theoretical and practical) instruction, and productive labor | -- | -- | -- | -- | -- | -- | -- | -- | 12 | 12 | 12 |
| Total | 3 | 3 | 5 | 5 | 6 | 6 | 7 | 6 | 14 | 12 | 12 |

Actually, the curriculum reforms are in a state of broad experimentation, and each year, no doubt, changes will be made in the light of the experience gained. For example, the programs worked out for grades 9, 10, and 11 are on "probation" for the first year or so. The overall aim, however, of these new reforms has been to develop an ***11-year elementary-secondary general polytechnic school.***

## Implications

The Soviet idea of placing emphasis not only on mathematics, science, etc., but also on workshop type courses that acquaint all pupils with the technical side of Soviet life, is an idea that might well be given serious consideration in the United States. As already pointed out, these courses complement the mathematics and science instruction through the technological. This type of education provides pupils with a broad base academically and technically in order to prepare them to live more intelligently in a highly industrialized society.

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[1] William K. Medlin, Clarence B. Lindquist, *and* Marshall L. Schmitt, *Soviet Education Programs*, Washington, D.C., U.S. Government Printing Office, 1960. (U.S. Department of Health, Education, and Welfare, Office of Education Bulletin 1960, No. 17) pp. 222–223.

One of the values, Soviet educators feel, that stem from their polytechnic courses is respect for work and property (personal and State). These values are universal—important for both countries—and they have even greater significance in the United States since students here have more material goods and services than do those in the Soviet Union. The dignity of work, the respect for labor, the return of a full day's work for a full day's pay, and the development of pride in one's work are values that must be instilled in pupils. This same idea can be carried over into science classes and other classes as well. Not only can the application of science be made in these disciplines, but work attitudes, also.

The idea that there is no dividing line between pure physics and applied physics, between pure mathematics and applied mathematics, puts mathematics, science, and technology—the user of these disciplines—on a more balanced basis. This has implicati[illegible] for industrial arts education, since it deals in technology, to become even more closely connected with these disciplines. This would imply that industrial arts should be more experimental and more scientific, especially for those students aspiring to be engineers and scientists.

Also, the notion that "practical arts" are for slow students only must be dispelled. These kinds of courses do help slower, less able students, but they also provide a stimulus for able students as well. The idea of requiring all pupils to take these courses is well established in the Soviet Union.

One of the dominant factors in a highly industrialized society is mass production. This economic method of producing goods with the utilization of tools, materials, processes, and personnel organization has its own set of principles. The advent of automation puts even more emphasis on the need to understand the principles of mass production with all its implications. The industrial arts courses in the public school should be the vehicle to develop this important concept. Automation, instrumentation, electronics, power mechanics, etc., should be reflected in the program more than they are now.

It is imperative that industrial arts develop the fundamental technical knowledge and understanding needed by all students so they can draw upon this solid base of technical information as they enter into adulthood and make their vocational choices as technicians, skilled workers, engineers, lawyers, architects, or regular workers. The industrial arts curriculum area serves the pupils in the same way as language arts, social studies, art, and other general education courses. Just as one must understand the vocabulary and concepts in written documents, such as *freedom*, *rights*, etc., so must one understand the ideas of technology that make this material culture possible. With an understanding of all of these ideas, each in its proper perspective, science and technology can better serve mankind in achieving higher human values.

Where the language arts teach the individual to communicate his ideas effectively, the industrial arts teach the individual to express himself creatively with tools, materials, and machines—and to understand how to make the products available to all persons. The process is similar; only the vehicle is different. In the language arts, written or spoken words are used; and in the industrial arts, the tools, materials, and machines are used.

A student in an American school, in order to have a background and experience similar to a Soviet student at the elementary-secondary general school level, would need to study industrial arts, art, and drawing at all grade levels and to participate in a work experience education program in the upper grades, as well as to study mathematics, science, foreign language, native language, social studies, and physical education. If Soviet educators actually adopt their present educational reforms in 1963, they will provide 11 years of complete elementary-secondary schooling for their students, or approximately 12,699 hours. Our present 12 years of elementary-secondary education has about 10,710 hours. With the length of our present school day, we would have to increase our present 12-year school system to about 14 years to get about the same number of hours of instruction. Whether the call of the 1960's will be to extend the common school of America to 13 or 14 years, or to lengthen the school day, or the school year, or to provide some other way to improve education, only time will tell. The basic problem is not to provide a program patterned after another country whose needs are different but to develop and utilize ideas that might provide a better education for American students, while fostering the development of democratic ideals.

## Educational Issues

A main issue facing the American people today is to discover the proper balance in the public schools for the scientific, the technological, and the humanistic. All are essential elements of education at this juncture of history, and to be liberally educated today, one needs technical understanding. The material culture of all countries is dependent on the utilization of science in technology and the humanities. A major question is how should science and technology be used to better mankind.

Another main issue facing education today is the place of specialized education in the public school. Should the public school prepare to develop fundamental, basic knowledge to enable a student to specialize upon graduation from this common school, or should this common school prepare for both general and special education?

Another issue that has worldwide implications is the value of work experience as a part of the total education plan. Soviet general education uses work experience primarily as the vehicle to obtain general education goals and as a supplementary goal to developing not specialists, not technicians, but competent workers. Other countries of the world, especially the underdeveloped areas, may find this system of education the way to increase rapidly their material culture. Thus, their standard of living can make considerable gains within a short span of years. A work-experience-type education program is relatively inexpensive, flexible, broad in scope, and can be organized in a comparatively short period of time. Students in a work-experience program get first-hand knowledge of the world of work while they learn to become an integral part of the society of which they find themselves a part; in addition, they contribute to the economy and, at the same time, acquire an education.

## Summary

One of the basic purposes of intercultural exchanges is to give serious thought to any new ideas and new information which could profitably be used to improve education in this country. Already we have seen the evidence in the increase of mathematics, science, and foreign languages in the public schools. This report implies that there are other ideas worthy of consideration. The following statements represent a summary of some of these ideas which should be discussed by all American educators, but more specifically, by industrial arts educators.

1. The idea that industrial arts be more closely connected with mathematics and science has merit. This has been a trend in the United States for the last few years. This should continue, especially on the senior high school level, with courses like metallurgy, automation, power mechanics, drafting, and electronics.

2. If more required time were devoted to industrial arts in the elementary school, more depth could be achieved at the junior and senior high school levels. The belief that industrial arts is for all students has not been realized to a large extent in this country. It is usually required only in grades 7 and 8 and elective in the senior grades. Little, at present, is done at the elementary level.

3. The real values of industrial arts have centered around general education aims, such as developing proper work habits and safety attitudes, encouraging creative talents, providing guidance, and understanding industry and industrial products. Industrial arts educators might well consider putting more emphasis on: (1) the applications of the principles of mathematics and science, (2) the principles of mass production, and (3) the development of desirable work habits and attitudes.

4. The idea of students receiving monetary returns for work done while in school is not a practice here in the United States. This is an illustration where the economies in the two countries differ. Goods are still scarce in the Soviet Union and any kind of work must be devoted to the total economy; whereas in the United States there is an overabundance of goods.

5. The idea of garden plots for related science instruction and the development of cooperative work attitudes has merit and is worthy of experimentation.

6. The notion that practical arts has value *only* for slow learners should be dispelled. There is *value* for all students—bright, average, and dull.

7. The idea of a closer connection with industry, utilizing a work experience program, has some merit, especially for some students. The problems of industry would become more real and meaningful to the student with this kind of program. Many obstacles would have to be overcome, but this idea should be explored. Some of the present vocational training programs in the United States use work experience effectively in their cooperative-type programs. Some work experience programs are used for general education purposes, too.

8. Since agriculture has become so mechanized and scientific, would a combination program of agricultural and industrial arts be possible? Experiments might be established in selected communities and then evaluated.

9. There is considerably more emphasis on manual skill development at the lower grade levels in polytechnic education than in industrial arts. During our visit, Soviet educators expressed concern over this emphasis. They would like to decrease this aspect in favor of other values. Industrial arts emphasizes understanding, appreciation, and attitudes, rather than manual skills; and it would lose much by changing this emphasis. This point should not be construed to mean that good workmanship is overlooked—pride in one's work is a definite goal of all industrial arts programs.

10. The obligatory curriculum from the Soviet Ministry of Education has some merit because it does provide a common effort toward certain predetermined goals; nevertheless, because of lack of equipment, facilities, and properly trained teachers, there is variation within Soviet polytechnic education. Also, the mandatory-type curriculum leaves little time for individual experimentation by the teacher, and "covering the ground" does not insure that the students learn.

As the forces of the Soviet economy and education come to grips with the educational reforms in their general schools, difficult problems must be overcome before their goals can be fully realized. For example, Soviet educators face a number of problems: (1) the training of teachers qualified to teach "polytechnic courses" in woodworking, metalwork, and fundamentals of production; (2) the reorientation of academic teachers and administrators with the philosophy of polytechnic education; (3) the effective coordination of industrial and agricultural work experience with the school curriculum; (4) the determination of production work which is educationally and socially useful for the school to produce; (5) the shortage of needed workshop facilities and equipment; and (6) the effect of this new educational reform on the present vocational schools.

## Discussion Highlights

Colored slides were shown as a part of the presentation in Soviet polytechnic education. Prior to the showing, three points were emphasized: (1) the slides dealt with only the general education schools (elementary and secondary) in the Soviet Union; (2) polytechnic education simply defined is the study of the technics of industrial and agricultural production and the application of science and mathematics; and (3) the Soviet schools are, at present, going through a tremendous change. The slides dealt with views about labor training, garden plots, laboratories, technical drawing classes, displays, production work, shop classes, electrotechnic classes, tractor shop, and others.

Some of the comments made during the viewing of the slides were as follows: (1) the workshops remind one of the manual training days in America about 50–60 years ago; (2) the school buildings looked old and in a poor state of repair; (3) lighting in the workshops was poor; (4) workshops for the various polytechnic courses were small by our standards; (5) each student had his own set of tools; (6) the hand planes used in woodwork were made of wood except for the plane iron; and (7) the individual woodworking benches had two wooden vises.

If industrial arts laboratories are to reflect the modern trends in industry, they will have to be modernized. Many new manufacturing plants in the United States are well lighted and convenient to work in.

As revealed by the tables in the written report, there is considerably more emphasis being put on polytechnic education. It must be remembered that this change of emphasis is still probationary—that is, it is not fixed and may be changed as new research is brought to bear on the problems involved. Nevertheless, the first five grades are supposed to be functioning on the revised program this year.

What is it they do differently in polytechnic education from what we do in industrial arts in this country? The report points out these differences; however, one of the main differences is the emphasis they place on understanding mass production and the actual work experience in and out of school.

There was considerable interest in the White House Conference on Children and Youth as to whether or not we shelter our children from learning about "work." There was concern for developing the proper attitudes toward work at the White House Conference. The discussion at the Conference was on the general topic: Transition from School to Work.

Is there exploitation of youth in doing mass production work in school and in the work experience education programs at the factories? The program observed was not exploiting youth, in the opinion of the observation team. As was pointed out at the conference, there are some real educational values inherent in the work experience programs. The primary aim is to achieve an understanding of industry. However, the observation team felt that in the last year of the 11-year school there was more emphasis on skill development in the work experience program than on general educational values. Nevertheless, industrial skill development is a supplementary aim of the new reforms.

The workshop and production-type education being given to Russian children now is not much different from that given to some European children. The significance of the Russian plan is that *all* students, including those planning to go to college, must take these workshop courses. This is something considerably different. Students who have this experience will develop attitudes toward work that will be much more meaningful for both the student who goes to work after secondary school or attends college.

It would not do in our country to go into mass production to the extent that the Soviet students perform this activity in school. We do not have shortages in tools, equipment, and products of the kind school children produce. The Soviets do have these shortages, and every contribution, however small, helps alleviate it.

An important point to remember is that the 11-year school will actually keep students in school for an additional year at a time when the Soviet Union needs all the workers it can get. As we know, the losses suffered during World War II and low birth rates during the war made it difficult to maintain or advance production rates. This additional year of schooling, even though it provides work experience, will decrease production goals, rather than increase them. And, as a requirement for higher education, students must now get 2 years of experience in industry before they can be admitted into higher educational institutions. This is the general plan, but there are some exceptions. Just how this cooperative school work experience in industry or agriculture will be counted toward this requirement for higher education is not known.

Are there specific requirements in the workshop courses for the students? There are specific requirements that the student must complete during the course. He can then make some individual articles for himself. This is very similar to our plan here in the United States.

Students who attend European academic high schools do not, as a rule, take summer jobs as do students in this country. Parents of our students encourage paper routes, summer jobs, etc. This is not true in Europe for the university-bound student.

Only about 30 to 40 percent of the students at Moscow University come from parents of industrial workers or farmers. The rest of the student body is made up of students of the "intelligentsia." This is not good, according to Khrushchev.

One can derive several implications from Soviet polytechnic information that may apply to industrial arts. Several of these are given in the written report; for example, their belief that there is no sharp dividing line between pure science and applied science, between pure mathematics and applied mathematics; their belief that understand mass production is important to understanding industry; and their belief in the dignity of labor. These ideas have merit, and industrial arts would benefit if it would become more technical and scientific; communicate the concepts of mass production to the students; and reemphasize the value of work and insist on its high quality.

From an educational standpoint, the two countries (Soviet Union and the United States) are going in diametrically opposite ways. We are decreasing the applied aspects of our school curriculum and they are increasing theirs. They require more "practical arts" in their total school curriculum than we do in ours.

For the last 5 years the Soviet Government has demanded a change in their educational system to help further the economic and industrial development of their country. As a result, the proposed polytechnical education was put into effect in their general schools.

These general polytechnical education schools with workshops, including work experience in industry, provide pupils with 11 years of education. Upon completion, these pupils will be absorbed by industry (agriculture, business, etc.) and higher education. Other schools include: (*a*) Vocational education schools for pupils who have completed 8 years of compulsory education. These pupils continue 2 or 3 years of practical training while working in factories or on farms. (*b*) Specialized professional training schools (Technicums) for technicians needed by the State in various branches of industry are provided by schools attached to plants and agricultural enterprises. (*c*) Special secondary schools in music, dancing, sports, etc., for gifted boys and girls. (*d*) Boarding schools with 10 or 11 years of training stressing general polytechnical education.

Russian educators argue that the new educational plan will be a "multiple track system" and will eventually replace the regular academic 10- or 11-year school program. About 60 to 75 percent of pupils who graduate from the 8-year school will go directly to work, or will be attached to schools for working and rural youth. About 15 to 30 percent will be enrolled in the 9th, 10th, and 11th grades and graduate in the general polytechnical 10- or 11-year schools. The remaining 10 percent will be enrolled in "Technicums."

# What Is the Relationship of Industrial Arts to Other School Curriculum Subject Fields?

*by*

***Robert L. Woodward***

THIS report and the accompanying guide[1] and mathematics publications[2] represent the "working paper" for my assigned topic, which is "The Relationship of Industrial Arts Education to Other School Curriculum Subject Fields." Notice that the term "Subject Fields" has been used instead of "Areas" in the topic title. Other school curriculum subject fields as well as industrial arts have "areas" and "subareas."

Industrial arts experiences have reinforced, applied, and extended: (1) language arts, through the use of instruction sheets, technical books, and reference material as well as through the introduction of words and terms relating to industry; (2) scientific principles, through activities and related instruction; and (3) mathematics, through activities requiring mathematical solutions.

Industrial arts education provided in the elementary and secondary schools of the United States is rich in opportunities to reinforce and apply the content of other school curriculum subject fields. The following areas are included within the subject field of industrial arts: Auto Mechanics, Drafting-Industrial Drawing, Electricity-Radio-Electronics, Graphic Arts-Printing, Handicrafts, Metalworking, Photography, and Woodworking.[3] All of these industrial arts areas provide experiences that reinforce the content of most other subject fields and all of these industrial arts areas provide activities that apply much of the content of certain of these other subject fields.

A brief statement of the relationships of industrial arts to the total program of education[4] follows.

Industrial arts education has many factors in common with other subject fields, such as content, principles, academic skills, knowledges, and attitudes. The following examples list some typical relationships.

*Relationship of industrial arts to fine arts:* Students apply knowledge of materials and tool processes to design. The adapting and combining of design elements in projects is encouraged. Ability to recognize and appreciate good design and construction is developed. Opportunities are provided for creative activity. Acquired technical skills are applied to design and construction problems in the fine and dramatic arts.

*Relationship of industrial arts to health and recreation:* Students develop safety attitudes for home, community, and industry. Personal hygiene is practiced. Students learn to build recreational equipment. The therapeutic values of working with tools and materials as hobby and recreational activities are emphasized.

*Relationship of industrial arts to language arts:* Students utilize oral and written communication in school shop activities. Vocabulary is increased and enriched through the understanding and use of industrial terms. Special language skills are developed by writing technical reports, specifications, material orders, and by using handbooks, catalogs, books, and reference materials.

*Relationship of industrial arts to mathematics:* Students make extensive use of measuring processes. Accuracy and computational skills are developed. A wide range of experiences is provided in the use of symbols and formulas. Computations are an integral part of many processes and jobs. Concepts of tolerance are developed. Skills are acquired in the estimating and judging of size, quantity, and fit.

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[1] California State Department of Education. *Guide for Industrial Arts Education in California, rev. ed.* Sacramento, 1958. 39 p.

[2] California State Department of Education. *Mathematics and Industrial Arts, Grade 7–12.* Sacramento, 1960. 100 p.

[3] Guide for Industrial Arts Education in California, p. 20.

[4] Ibid., p. 7.

*Relationship of industrial arts to science:* Students are given opportunities for research, investigation, and experimentation. The scientific method is used in solving problems in the school shop. Mechanical skills are developed which are necessary in the construction of equipment for scientific experimentation.

*Relationship of industrial arts to social studies:* Students practice democracy in establishing procedures for shop management. Effective human relations are developed by student participation in shop management, by working together, and by sharing tools and facilities. Emphasis is placed on conservation when studying human and physical resources. Industrial materials and production methods are studied. A knowledge of history, geography, and economics is gained through the study of industry.

*Relationship of industrial arts to vocational education:* Students obtain information concerning requirements of occupations and discover vocational interests and aptitudes. Technical knowledge is applied to the solution of typical industrial problems. Tool and machine skills and accuracy are developed. Mass production, planning, and manufacturing techniques are used. Advanced students have an opportunity for some concentration in an industrial occupation.

The topic under discussion does not require proof concerning the richness of opportunity of industrial arts to assist in making other subject fields more meaningful, but requires an answer concerning the extent of this assistance. To this end, many educational leaders have developed curriculum material that emphasizes the importance of reinforcing, applying, and extending other subject fields through the experiences provided in industrial arts education. The six California State industrial arts publications emphasize this relationship.

A 2-year study[5] entitled "The Application of Mathematics in Each Area of Industrial Arts in Grades Seven Through Twelve" was begun in 1957. More than one hundred California industrial arts teachers, supervisors, and teacher educators participated in this study.

It was found that the practical use of mathematics in industrial arts courses helped students deepen their understanding, improve their skill, and extend their appreciation of the mathematics they acquire in regular mathematics courses, and that they also acquire insights through industrial arts experiences that intensify their interest in mathematics.

Basic information provided by the study was used by the members of the Mathematics-Industrial Arts Committee during a workshop conducted under the provision of the National Defense Education Act in the preparation of the material for the bulletin previously mentioned, entitled *Mathematics and Industrial Arts, Grades 7–12.* This bulletin is designed to assist both teachers of mathematics and teachers of industrial arts. More than three hundred examples of industrial arts activities involving the use of mathematics are presented. Each example lists the mathematics involved, shows the practical application of the mathematics in a specified industrial arts activity, and furnishes keyed references to sources that may be used to secure information needed.

I heartily subscribe to the point of view expressed in a letter[6] from James McKinney when he referred to the publication on *Mathematics and Industrial Arts, Grades 7–12.*

> The thoroughness and quality of the task is reflected in the large number of experienced teachers who carried out the analysis and research work. The study will do much to enrich the material which the math teacher has to clothe his subject, and at the same time possibly surprise the average industrial arts teacher on the wealth of mathematics which is to be found in the related subject work of his shops.

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[5] Conducted by the Professional Committee on Industrial Arts Education of the California Association for Supervision and Curriculum Development, the State-wide Industrial Arts-Mathematics Study Committee, and the California State Department of Education.

[6] Letter from James McKinney, Chairman of the Board of Trustees of the American School and the Technical Society, and a member of the President's Committee on Higher Education, April 15, 1960.

> The coverage is good for all branches of industrial arts work. I am also sure there will be a big gain in understanding and mutual respect of both math and industrial arts teachers and also in the subjects which they teach. The Mathematics Index will prove valuable to all who are interested in a topical approach. The bibliography is an excellent source of teaching material in the various branches of industrial arts work.
>
> Seeing that you have made such a fine start in the field of mathematics in correlating the subject matter of the shop with the mathematics of the classroom, perhaps we should next make a similar try in the correlation of craftsmanship and science. Craftsmanship is important in scientific research; examples of this are found in the lens makers who have made modern astronomy and biology possible. The instrument maker is the heart of much of our testing and recording equipment. This correlation between science and industrial arts has, in my judgment, great possibilities.
>
> Perhaps we need a better correlation between the English department in the school and the other activities such as industrial arts and home economics. English should be everybody's business, and I have a feeling that we would get much better written work in the classroom if it were related to the other activities in which the students engage. Doing is important in the school shop and being able to tell another person what he has been doing and enlightening him about the difficulties of his success or failure in a project is also a valuable experience.

At the present time we are conducting a study entitled *The Application of Science in Each Area of Industrial Arts in Grades Seven Through Twelve.* The results of this study will be used in preparing the material for a bulletin entitled *Sciences and Industrial Arts Education.*

The following excerpts from instruction sheets for a TV lamp[7] and a nutcracker[8] show the relationship of industrial arts to language arts, mathematics, and science. The TV lamp consists, essentially, of a band-iron base, 5 inches in diameter, with 3 legs 1¼ inches high. A flexible material, forming the shade, is rolled into a pipe-like shape and fitted into the base. The metal parts can be welded or brazed together. The nutcracker is a more complicated project involving machine tool work. It is made from metal, approximately 1 x 2 x 6 inches, and clamps to a table top. A pinion gear, rotated by a handle, causes a rack to move up and down providing the necessary motion. As the students make these articles they will learn new technical words and utilize many mathematical and scientific principles. Other illustrations could be used.

## Application of Language Arts, Mathematics, and Science in Making a TV Lamp Project

### VOCABULARY

| | |
|---|---|
| Brazing | Hard-soldering using brass rods. Used for joining like or unlike metals without melting them. |
| Burr | Sharp edges left on metal when cut, filed, or ground on a grinder. |
| Cylinder | A hollow tube with parallel sides. |
| Gauge | A standard of measurement indicating the thickness of sheet metal. |
| Mandrel | A round pipe or rod used for shaping metal. |
| Oxyacetylene | Oxygen and acetylene used in combination to produce heat for welding, brazing, and burning metal. |
| Perforated metal | Sheet metal with a design punched in it when manufactured. |
| SynSkin | A clothlike material used for lamp shades. |

### MATHEMATICS

Measure all parts of lamp.
Compute area of sheet metal.
Find circumference of a circle or cylinder. (pi × dia.)
Use micrometer to determine thickness of sheet metal.
Find circumference of a circle or cylinder by using a circumference rule.
Select correct size twist drill for drilling.
Set regulator gauges on oxygen and acetylene tanks.
Make price list of all parts and compute total cost.

### SCIENCE

Effects of oxidation on metal.
Carbon content of steel determines its hardness.
Galvanizing steel.
The effect of heat on metal when welding and brazing.

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[7] Excerpt from an instruction sheet developed by Gerald H. Young, industrial arts instructor, Sutter Junior High School, Sacramento City Schools, Sacramento, Calif.

[8] Excerpt from an instruction sheet developed by Adrien J. Bord, Sacramento City College, Sacramento, Calif.

## Application of Language Arts, Mathematics, and Science in Making a Nutcracker Project

### VOCABULARY

| | |
|---|---|
| Acetone | A chemical, inflammable liquid used as a solvent. |
| Buffing compound | An abrasive usually used in a polishing operation. |
| Clearance | The space between parts. |
| Linear pitch | The distance from one tooth to the next tooth. |
| Peening | Hammering or flattening metal. |
| Precision fit | Accuracy of limitation. |
| Rack gear | The same as a spur gear except the teeth are on a straight line. |
| Scriber | A pointed piece of steel used to mark or scratch on metal. |
| Spur gear | A series of uniform teeth on the periphery of a cylinder. |
| Solvent | A solution to dissolve another substance. |

### MATHEMATICS

- Figure spur gear specifications.
- Calculate rack gear specifications.
- Figure mechanical advantage.
- Figure decimals.
- Compare weights of steel and aluminum.
- Measure internal bearing.

### SCIENCE

- Flammable materials.
- Lever and fulcrum.
- Chemistry of peening.
- Corrosion of metals.
- Composition of metal dye.
- Abrasive action.

## Discussion Highlights

Some of the States are working to develop a guide for the improvement of instruction in mathematics courses relating to industrial arts in grades 7 through 12; but as yet have not produced detailed bulletins on them as has been done in California.

In California there are more than 4,000 full-time and part-time teachers of industrial arts. The enrollments in industrial arts are around 500,000 students, grades 7 through 12.

One of the largest problems to overcome in industrial arts is financing. With the burgeoning enrollments, it is difficult to build facilities to take care of the students that are now in schools. For example, in California, the last survey indicates 52 percent of the students in junior high school are enrolled in industrial art courses. In senior high school the percentage varies from 38 to 75 percent of the total number of students.

One of the things California is doing is to involve teacher educators, State supervisors, and classroom teachers in the preparation of curriculum guides. In the last publication, *Mathematics and Industrial Arts Education*, 104 people were involved in its development.

The instruction sheets entitled (1) *How to make a T.V. lamp* and (2) *How to make a nutcracker* are two illustrations of how industrial arts is related to other subject matter areas such as, language arts, mathematics, and science. The instruction sheet dealing with the TV lamp is for the junior high school, and the other is for the senior high school. The instruction sheets are developed for the average student. The application of language, mathematics, and science is shown on the last page of the instruction sheet. It illustrates the close relationship with these studies showing specifics in vocabulary, measurement, and related science. Seminars are being conducted this year for the implementation of the mathematics courses industrial arts students take. The seminars will include supervisors of mathematics and industrial arts, teacher education personnel, and prospective teachers.

There is a tendency for mathematics and science to lean to the pure and abstract. Therefore, there is a need for an emphasis on the practical application, and the understanding of technical words. Teachers should continually identify activities in industrial arts which involve mathematics and science. We do not want to discard existing offerings in industrial arts.

Industrial arts teachers have a real need for adequate preparation in mathematics and science in order to give more emphasis to technology, especially at the senior high school level.

Another 2-year study by the State of California is being conducted in science and industrial arts, but the results of this study, no doubt, will be different from the *Mathematics & Industrial Arts Education Study* because a new approach is being made.

Certain courses in industrial arts could be applied science courses, such as, electricity-electronics, metallurgy, and advanced metal courses.

Should industrial arts be projected into other subject-matter areas, or should it enrich its own area? What is the industrial arts profession trying to prove by showing its relationship with other areas? What should be done is to make the subject matter of industrial arts more meaningful and get out of the stage of making projects, considering only skill, and forgetting the intellectual content.

Mathematics and science personnel, if they had their choice, would rather be concerned with the theoretical aspects of their subject, than with their application.

The recreation objective of industrial arts cropped up again in the discussions at this point, and the statement was made that an application of science and mathematics can be made through craft work. However, it was suggested that the primary purpose of teaching craft work was to relate it to recreation. A statement was made that some physicians use woodcarving for relaxing after strenuous work and that many of them receive instruction in industrial arts classes. Another point made was that you didn't need to have industrial arts to learn woodcarving, and that anyone would have a difficult time justifying industrial arts programs on the "hobby" basis.

A comment was made about a research study completed in 1955 indicating that more emphasis should be placed in teacher education programs on experience and understanding in the field of science. Particular reference was made to the study of light, electricity, heat, mechanics, metallurgy, inorganic chemistry, mathematics, and drawing. Also, more emphasis is needed by the teacher to develop abilities, to analyze, to diagnose, and to comprehend technical situations, etc.

We don't want to run a "Crafts" program, but sometimes you can't draw a line between the "crafts," for example, and industrial ceramics. Many crafts or hobbies, such as photography, have their industrial application.

We must be cognizant of the fact that industrial arts is only one of the curriculum areas in the school. This provides one effect on the student along with the rest of the school program and the community. The industrial arts teacher must provide the kind of program that meets the student's needs and challenges him as much as possible.

Industrial arts is that part of a total educational program for all youth which is concerned with the development of a practical understanding and appreciation of today's industrial and technical society. Opportunities for learning are provided through experience in planning, using tools and materials, performing processes in the production of useful articles, servicing industrial products, and experimenting in activities related to the science of industrial and technical problems of the world today.

A well-developed program of industrial arts endeavors to make the following contributions: provide students with experiences and knowledge common to our industrial society; provide an opportunity to solve practical problems of a technical nature; develop proper safety habits in the use of tools, machines, equipment, and materials; provide information necessary for the intelligent selection, use and care of industrial products; develop an understanding and appreciation of mass production methods through group projects; develop handyman skills and knowledges which will encourage more effective home management; provide the know-how which promotes more effective use of leisure time through constructive and enjoyable activities; contribute a background for occupational guidance which may eventually lead to a more intelligent selection of a vocation; relieve tensions and provide opportunity for social and emotional expression; provide a foundation for future technical education which may eventually lead to increased specialization in an industrial, scientific, or technical pursuit; afford greater opportunities for initial employment through the development of marketable skills; develop skills and knowledge in sketching and drafting which encourage the expression and interpretation of technical ideas; and encourage a realistic interpretation of abstract ideas through the practical application of mathematics, science, and other academic knowledge.

# What Changes Are Needed in Industrial Arts To Meet the Needs of the Gifted and Slow Learner?

*by*

*John A. Jarvis*

THE VARYING of instruction and content is certainly not a new or unique idea. Rousseau said, many years ago, "Put questions to him adapted to his capacity and leave him to resolve them." Fellenberg also provided a three-track school for students whose background and grades were quite diverse. Runkle, too, believed that it was necessary to vary instruction and content, stating, "Another value of the system is that it is equally well adapted to the wants of each class or grade of students."

The preceding quotations indicate clearly that the idea of the varying of content should not be considered either a new approach or a novel concept.

Mathematics classes in many secondary schools today are designed for students of varying abilities and objectives. Mathematics courses for those high school students who are preparing to enroll in an engineering college and who have the ability to succeed in such an endeavor are quite different in content from those classes which have been developed for slower students with other objectives.

Our problem in industrial arts is similar. Drafting and shopwork for those who will enter engineering colleges should not be the same as courses planned for students who will enter a trade, a vocational-industrial training program, or employment as production workers. Instead, industrial arts courses should vary in content and in projects to be constructed or completed.

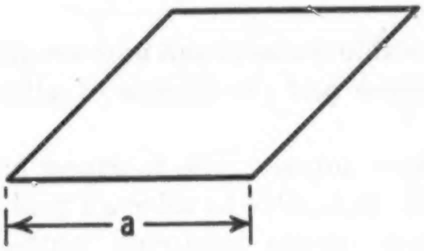
Too often the only difference between, for example, a course in drafting for young men preparing for entrance into a college of engineering and a course for those enrolled for other objectives has been merely in the drawings (projects) assigned. The faster, more able students, under the guise of being enrolled in an enriched course, have merely been required to complete more of essentially the same kind of drawings completed by all others in the same class. Rather, drafting for pre-engineers should include as much mathematics and science as possible because engineers do not draw; they design, which is quite a different activity. For instance, the design of a punch press (designed, not copied) may necessitate 25 pages of computations before an actual drawing of the press is attempted! Such computations may well require knowledge of integral calculus.

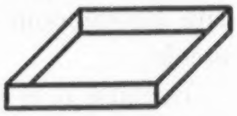
Drafting for secondary school students who will enter engineering colleges should, therefore, include design, mathematics, and science. However, other high school students who will enter a trade or employment as production workers should have some practice in the reading of drawings and prints because their eventual duties will require them to read drawings—not make them. Application of mathematics will therefore not be as important to this group as to the preengineering group. The "skill part" of drafting should be emphasized for still another category of students, those who are interested in employment as draftsmen after graduation from high school.

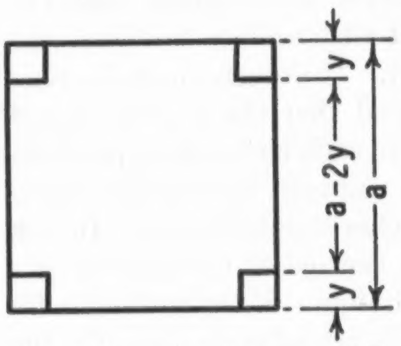
Design, problem-solving, and the application of science and mathematics can and must be included in shop work. For example, the operation to divide spaces with a rule is based on the following theorem: If two transversals are cut by a series of parallel lines, and if this series of parallel lines intersects equal segments on one of the transversals, they intersect equal segments on the second.

Therefore, having discussed, in a general way, possible variation in industrial arts content to meet differing student abilities, let us now examine a specific example which demonstrates how a single problem can be varied in difficulty to challenge the gifted, the average, and the below-average. An example of the application of mathematical principles to a rather simple project occurs in the following problem of constructing a square sheet metal pan.

**Design and Construct from a Square Sheet of Tin Plate Which Side Is "*a*" Inches a Square Pan of Maximum Volume**







Problem to be solved by use of three different methods:

*Method employing calculus:*

$$V=y(a-2y)^2$$

$$V=y(a^2-4ay+4y^2)$$

$$V=a^2y-4ay^2+4y^3;\quad \frac{dV}{dy}=a^2-8ay+12y^2$$

$$0=a^2-8ay+12y^2$$

$$0=(a-2y)(a-6y)$$

$y=\frac{a}{2}$ Reject this solution

$y=\frac{a}{6}$ Accept this solution

A square pan of maximum volume will result when its sides are 1/6 *a*.

*Method Employing Graph, General Solution:* Ninth-grade students should be able to construct graphs and, therefore, should have the experience of solving the same problem graphically. The first graphical solution involves a square sheet, each side is "a" inches.

Utilizing the formula $V=a^2y-4ay^2+4y^3$ and then substituting several values for "*y*" in terms of "*a*", it is possible to calculate the several volumes indicated in table A:

**Table A.—Calculated Volumes for Several Values of *y***

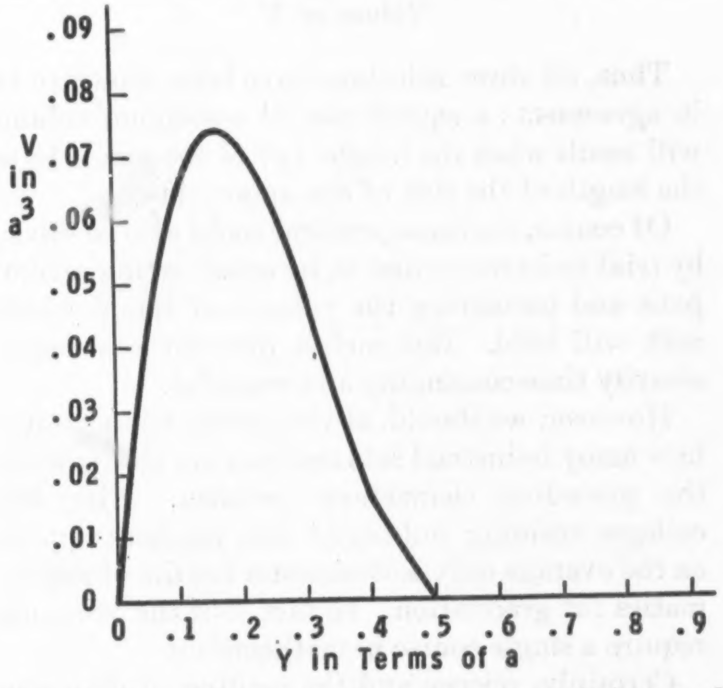
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *v* | *O* | 0. 064*a''* ³ | 0. 0735*a''* ³ | 0. 074*a''* ³ | 0. 072*a''* ³ | 0. 048*a''* ³ | 0. 016*a''* ³ | 0 |
| *y* | *O* | . 1*a''* | . 15*a''* | . 1/6*a''* | . 2*a''* | . 3*a''* | . 4*a''* | . 5*a''* |

By plotting values from table A, the graph shown at right is then constructed.

Inspection of the table and graph reveals that the maximum volume is obtained when the side of the pan is *a*/6 inches. This is in agreement with the earlier solution obtained by use of calculus.

*Method employing graph, specific solution:* High school students sometimes experience difficulty solving problems when solutions depend on manipulating a dimension of "*a*" inches, finding it easier to solve problems where definite dimensions are given.

The same problem is now solved for a square sheet which has a width of 4 inches.



**Graph A.—Calculated Values for *V* and Assumed Values for Y**

**Again utilizing the formula, $V = a^2y - 4ay^2 + 4y^3$, the student determines the values on table B merely by substituting values for $y$ and calculating $V$.**

**Table B.—Calculated Volume for Several Dimensions of $Y$**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $v$ | $O$ | 0 | 4''$^3$ | 1½''$^3$ | 2.8''$^3$ | 4.74''$^3$ | 4.69''$^3$ | 4.5''$^3$ | 4.7''$^3$ |
| $y$ | $O$ | 2'' | 1'' | 1½'' | 1¼'' | 2/3'' | 3/4'' | 1/2'' | .6'' |

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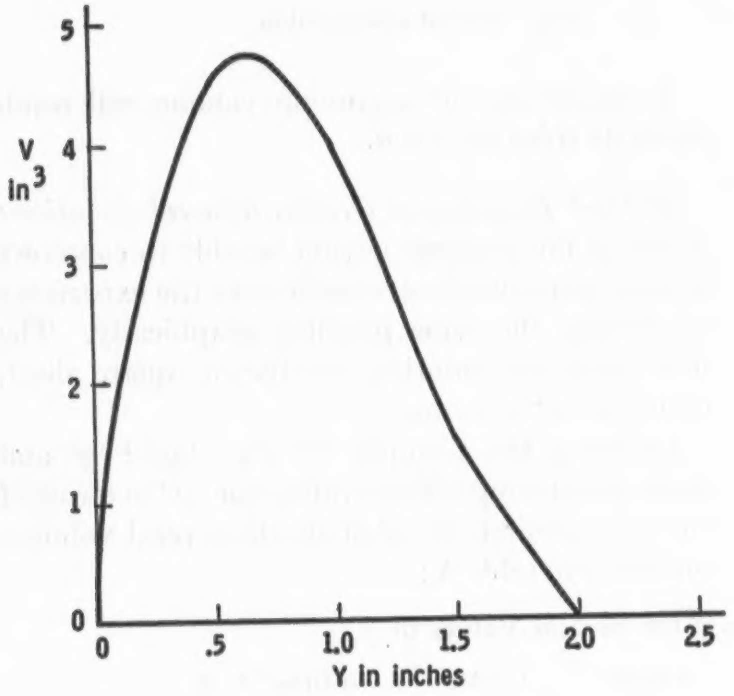
**A graph constructed from the values assumed and calculated appears below as graph B.**



**Graph B.—Calculated Values for $V$ for Several Values of $Y$**

**Thus, all three solutions have been shown to be in agreement: a square pan of maximum volume will result when the height ($y$) of the pan is ⅙ of the length of the side of the square sheet.**

**Of course, the same problem could also be solved by trial and error—that is, by constructing several pans and measuring the volume of liquid which each will hold. But such a procedure is unnecessarily time-consuming and wasteful.**

**However, we should, at this point, ask ourselves how many industrial arts teachers are able to solve the preceding elementary problem. Fifty-five colleges training industrial arts teachers require on the average only 4.59 semester credits of mathematics for graduation. In fact, 6 of the 55 do not require a single course in mathematics.**

**Certainly, science and the reading of diagrams and graphs should be included for all students studying the heat treatment of iron and steel in machine shop. More able students can understand the Roozeboom diagram and the science of alloy steels.**

**Because it is perhaps unreasonable to expect an industrial arts teacher to be able to solve all problems of a mechanical nature involving mathematics and science, the suggestion that an industrial arts student should be encouraged to consult with science teachers, engineers, etc., is excellent. However, in such consultations, it is to be hoped that the person consulted is not asked to solve such elementary problems as how to compute percentages, knowledge which any industrial arts teacher should possess. In other words, employing the service of consultants is a sound educational technique—if the problems for which we ask solutions are of such difficulty that an industrial arts teacher cannot reasonably be expected to provide the solutions.**

**However, not only does the field of industrial arts have important values for normal individuals of varying abilities, but also for persons who are handicapped. Wrobel,[1] in an experimental class for teaching mentally retarded students, selected a program which included projects or problems from several industrial arts areas: leathercraft, weaving, marbling, stick printing, woodburning, bookbinding, basket weaving, graphic arts, plaster of paris modeling, and soap carving.**

**In the leatherworking area, he found that belts, small handbags, wallets, and key cases were successful projects. Wrobel also reports that some of the more able pupils developed their own patterns for projects which they would make.**

**Johnson [2] advocates a similar program in industrial arts for the mentally handicapped at the elementary level, together with expansion to provide them with a variety of experiences in junior and senior high schools. He suggests also a work-**

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[1] Charles Wrobel and Palmer Reppe. An Industrial Arts Program for the Slow Learner. *Industrial Arts and Vocational Education,* Vol. 49, No. 7, September 1960. p. 49–50.

[2] William M. Cruckshank and G. Orville Johnson. *Education of Exceptional Children and Youth.* Englewood Cliffs, N.J.: Prentice-Hall, Inc., p. 222–224.

school experience program for those able to profit from such activity.

Hutchcroft[9] points out the need for research in the area of educating the mentally handicapped: "Needed are research studies that identify specific practices which have appeared effective in teaching the gifted student and practices appropriate for teaching the slow learner."

Yes, industrial arts has much to offer all kinds of students. Educators in this field can certainly challenge the more able student and, by varying the content which they select and method they employ, accommodate the slow learner.

## Discussion Highlights

Our teacher-training institutions should provide special training for those who are going to teach the more able student. Research indicates that teachers of gifted children must possess certain qualities, such as: (1) greater intelligence than the average teacher, (2) better subject matter preparation, (3) special talents for the particular course being taught, and (4) sympathy and understanding of the characteristics of bright children.

Mathematics is something we don't just inject into our program. We pick it up and use it in a natural way for all ranges of ability. It is not necessary to call it related information. It is all a part of problem solving and designing. In designing a machine, for example, it is not unusual to have 25 pages of computation before the actual drawing of the machine is attempted.

The calculus solution of the problem presented in the working paper has its consumer value. If you wanted to save material, this would be the way to solve your problem.

The three solutions for determining the maximum volume obtained from a square piece of tin present varying degrees of difficulty for students. The main point is that we don't have to inject mathematics into industrial arts—it is already there. We have only to use it. If we vary our instructional methods we will find the bright students eager to take the course.

Those who are going to teach gifted students need better undergraduate preparation in mathematics and science. For example, in a survey of all schools graduating more than 20 students, the mathematical requirements were 4.5 semester hours. Six of the schools did not require a single course in mathematics.

Industrial education (industrial arts and/or trade and industrial) college majors should complete at least one course in calculus before enrolling in physics. It would then be possible for these students to derive some of the physics equations and, as a result, apply the equations and principles of physics with some confidence.

Teachers must be prepared who are capable of handling the problems they must face if we expect them to apply mathematics and science to the solution of technical problems, then they must be qualified in these two areas. A minimum requirement here would be that students graduating with a major in industrial education (industrial arts and/or trade and industrial) must be as well qualified in mathematics and science as a high school graduate who has completed 4 years of mathematics and 4 years of science. We cannot hope to attract the more able high school student unless this is true.

A real practical problem for a principal is that he must provide the best program for all the students, not just the upper 10 percent, but the other 90 percent as well. Industrial arts makes it possible to teach students who have a wide range of ability. It is the singleness of approach to teaching that is the stumbling block.

The discussion brought out points regarding the example presented in the working paper as being too hypothetical. Some thought it was and supported their view with comments indicating that a source of mathematical problems can be derived directly from industrial arts activities. But, we in industrial arts need to use mathematics to solve problems, for example, the problem of making a container for a required volume.

One thing we must keep in mind is that there are "other doors" through which to reach gifted pupils than mathematics and science. We should look beyond mathematics and science. For example, at the conclusion of a drawing course, a bright student told his teacher that he wished he had studied fundamentals of drafting and fundamentals of machine operation rather than the type of drafting he had taken. The school drafting course was set up to meet what was believed to be the needs of an engineering-bound student, but in fact, did not stimulate or motivate him—other kinds of courses would have met his need better.

We need teachers who have competencies to teach upper-ability students. Teachers who can propose problems and who can let students reach out to make choices and decisions. This attitude must be developed by the teacher before he can really challenge the brighter students. But what happens in practice is that the students' work is evaluated for the most part on craftsmanship.

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[9] Robert C. Hutchcroft. Industrial Arts, *Encyclopedia of Educational Research*, ed. by Chester W. Harris (3d Ed. New York: The MacMillan Co.), 1960. p. 363.

Perhaps we have gone too far in preparing a teacher to teach a wide range of activities. At the high school level where there is a range of seven shops, can a teacher be prepared in all seven? Would it not be better to give a prospective teacher the experience and ability in terms of one or two areas of instruction? But it was pointed out that individuals grow not only in one direction or dimension, but in breadth as well as depth.

In addressing the problem of making industrial arts functional for upper-ability students several ideas were mentioned. These students do take industrial arts at the junior high school level, but we do not recognize them nor vary our content and instruction to stimulate them to take more in the succeeding years. This is the crux of the whole problem. Our senior high school program and methods of teaching do not challenge the upper ability-group.

# What Curriculum Changes Need To Be Made in Industrial Arts To Best Reflect Technology and the Needs of the Student?

*by*

*M. J. Ruley*

**INDUSTRIAL ARTS, in the curriculum of the schools of the sixties, should include the better elements of our basic program. We should build into our program those segments that need strengthening or revision and eliminate those segments that do not contribute to our aims and purposes. A practical approach is needed, not one that says "throw out what we have been doing and start over." Fifty years of steady progress in industrial arts education cannot be overlooked in the light of present-day technology and needs of students.**

**The structure of our present program is sound; it needs to be upgraded, given depth and breadth, depending upon the need in a given situation. We are not teaching all of the things we have outlined in most of our teacher guides or course outlines (guidance, correlation with other subjects, relationships with industrial processes and materials).**

**Industrial arts is an area in the school curriculum that can demonstrate opportunities for high-level creativity, problem solving, and a study of the vast technology of our industrial culture. Careful consideration should be given to upgrading course content and teaching methodology, then industrial arts can take its rightful place with other challenging secondary school studies.**

**The industrial arts laboratory stands unique as a facility and setting in which all education can be brought together and synthesized. Functional industrial arts and teaching will exploit this uniqueness and extend its benefits to all ages and levels of learning. We should emphasize those things which industrial arts and no other area contributes to the education of youth.**

**Industrial arts has the subject matter and activities to challenge the more able student. Attention should be given to the establishment of special high-level industrial arts classes that will attract pupils interested in science and engineering and give them the chance to put into practice the principles of many areas.**

**A minimum program for the more able, average, and less able needs to be established. This minimum program should be geared to the imperative needs of youth (junior and senior high school), characteristics of youth, and the present-day technology in which we live.**

**If we believe in the philosophy of the junior high school, industrial arts has a definite place in providing offerings in basic areas of industry.**

**At grades 7, 8, and 9, boys and girls should have the opportunity to receive instruction in multiple activity shops. (The first opportunity for practical arts instruction in most schools.) The instructional program should be designed to encompass a variety of beginning experiences with the common tools, materials, processes, and problems of industry.**

**The areas of instruction should include basic exploratory experiences in drawing and planning, woodworking, metalworking, electricity, graphic arts, power mechanics, and industrial crafts (others may be added). The program should include the following: (1) At least 9 weeks in each of the exploratory areas, for 1½ years, allowing 9 weeks in each of six areas; (2) further instruction (½ year in the eighth grade, and 1 year in the ninth) to be elective in basic areas or in others not listed; (3) the elective program to be scheduled for 1 semester in a single phase of industrial arts as previously experienced in basic exploratory areas. Such a program should be carried on whether in a one-teacher or multiple-teacher program.**

The amount of woodwork being taught under the name of industrial arts is out of proportion to its relative value in the curriculum area as a whole. Some schools are including crafts at the expense of subject matter which represents the "solids" in industrial arts.

Girls should have more opportunity to take industrial arts. Some experience in industrial arts for girls and homemaking for boys at the eighth grade level would give both boys and girls a better understanding of industry, the variety and types of jobs where girls and women will work, also skills and knowledge necessary for industrial and technical jobs.

Boys in the same manner would receive a better understanding of homemaking and the place a man must take, in cooperation with the wife, as a breadwinner and homemaker in our modern industrial society.

Grades 10, 11, and 12 should be maintained in shops, laboratories, or drafting rooms especially designed and equipped. Where possible, courses should be limited to a single phase of industry which will meet the needs of students with varying abilities, aptitudes, desires, and interests. Each course should be designed to extend for at least 1 regular school year (36 weeks, minimum of 5 periods per week). In some areas a double period should be used. It is here that some of our offerings need to be upgraded to meet the needs of students and present-day technology.

Offerings in industrial arts for the average student should be of the type we now have, with upgrading and better correlation with other subjects. Many practical applications of science, mathematics, art, language arts, and other subjects may be given meaning and thereby enhance instruction in industrial arts as well as other subjects.

A suggested time allocation should be made for so-called direct and indirect related instruction. With its physical setting and ability to make certain unique contributions to the education of youth which no other subject can make, industrial arts must never lose its identity and become just another theory course.

In most cases, students who take multiple activity type industrial arts in the junior high school do not have enough time in each area to develop any degree of skill or technical knowledge. For this reason, 1 year of a basic industrial arts subject is needed at the senior high school level. If the student did not have the opportunity to take industrial arts in the junior high school, he or she has missed the various experiences in a variety of areas of industry and must make a selection at the high school level without previous exploratory experiences.

After a basic 1-year course, more able students should be ready to do intensive research and planning, using new materials and processes and modern machines and tools that will give them an opportunity to do advanced work of an industrial nature.

Upon completion of such a course, the student will have gained skills and information that could very easily be occupational in nature. We should not be interested in terms, and whether a course should be called special, vocational, or general. Advanced courses in industrial arts and those of advanced courses in mathematics, science, or foreign language may all have vocational implications. If such courses are used in a future or immediate occupation they will have become occupationally oriented.

One of our future emphases, with the noncollege or college-bound student, could be *specific* training in some area so a student will have something specific to sell. Industrial arts will reach 10 students to the 1 that vocational (reimbursed) classes will reach.

Classes for the below-average student have been and will continue to be a problem, as will those for the above-average student. Some of these courses might be classed as Special Education, and much needs to be done in this area. Industrial arts will be called upon to assume a heavier responsibility for the education of nonacademic youth.

A course in disassembly of industrial equipment seems to work well with the below-average students who have trouble in regular industrial arts classes. Most of these students are not interested or able to reassemble or repair equipment; however, if those who have the interest or ability could proceed further in this work, additional skill and knowledge would be secured. Arrangement for securing such equipment can be made from government surplus, schools, or some local industry. Such a program sounds like busywork,

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but there is a relation to industry, materials, processes, and simple tools.

Thirteenth and fourteenth year (junior or community college) experimental laboratories, shops, and drafting rooms offering practical work in industrial arts relating to industry and technology should find many enrollees. Here again, such courses can and will become specific and give meaning to one's future employment, even though terminal or vocational courses, as such, are not taken.

Industrial arts in the elementary grades (K–6) consists, of constructive activities, which are a part of the common learning of elementary school children. Such activity should be closely correlated with the basic units for elementary education so that the results will be an integrated program of education.

Usually the activities take place in the classroom under the direction of the elementary teacher. Some schools provide a special room with a special teacher.

Emphasis on industrial arts courses should be at the secondary level.

The word "shop" needs to be dropped from our vocabulary as a subject and especially from being listed on student and school schedules. Industrial arts as a general curriculum area or the course itself should be used.

The following are some examples of course description, content, scope, and sequence of industrial arts, drawing, planning, and drafting courses taught in the Tulsa public schools.[1]

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[1] Course description used for industrial arts courses in Tulsa public schools.

## DRAWING, PLANNING, AND DRAFTING

| Grade | Course | Emphasis | References |
|---|---|---|---|
| 7 | Drawing and Planning (Exploratory). | Drawing and Planning provides the student with the opportunity to investigate some of the problems in and relative to the language of drawing. It provides a means by which a student may learn to visualize and express graphically his own ideas and interpret the ideas of others; it provides for self-expression through planning and doing. Drawing is offered to junior high school students in the seventh grade. It is designed to acquaint the student with the language of drawing and provide experience that will enable him to determine whether his abilities and interests lie in this particular field. Time, 9 weeks first quarter if possible. | *Introduction to Applied Drawing,*[1] McKnight Publishing Co.<br>*Drawing and Planning in Industrial Arts,* Bennett Co.<br>Tulsa Instructor's Guide. |
| 9 | Drawing and Planning (Basic). | Basic Drawing and Planning is a 1-year course for ninth-grade students who may be enrolled in shop courses at a later date. Its purpose is to help students learn how to make and use drawings in everyday life. Problems and activities are related to all kinds of school activities and interests. Many of the drawings deal directly with things made in the school shop. Other drawings are related to health, safety, geography, science, and social science. Many others help you with activities. Elective, 1 semester and/or 1 year. | *Drawing and Planning in Industrial Arts,* Bennett Co. |
| 10, 11, and 12. | General Drafting I and II | General Drafting develops a background applicable to most fields industrial in nature; creates basic understandings of industrial dependence upon the drawing medium for communication; develops latent abilities for creativeness and originality in design. The course includes instruction in orthographic projection lettering, pictorial drawings, sections, auxiliary views, working drawings, and a unit in architectural drawing. Recommended for engineering students and all other students who can profit from the training. | *Mechanical Drawing,*[2] McGraw-Hill Book Co.<br>*Technical Drafting Essentials,*[2] Prentice-Hall, Inc.<br>*Basic Technical Drawing,*[2] Macmillan Co.<br>*Drawing and Planning for Industrial Arts,*[2] Bennett Co. |

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[1] Tulsa-adopted textbook.

[2] State-adopted textbook.

Standard courses at the senior high school level are basic to any program of instruction. As previously mentioned, such courses should be available and used for the first course. Additional courses should be experimental, involving student and student-group research, with basic direction from the teacher.

Classes now offered and those proposed would meet the needs of most adults. As more time is available for hobbies, interests, and leisure-time activities, our adult program, including industrial arts, will increase. Adult courses should offer basic training if the adult student has no basic tool or machine skill. Flexibility should be the keynote to all adult classes. Workshops for every home should be the goal of all industrial arts teachers.

Industrial arts' greatest contribution to accelerated scientific education can be made through our offerings in electricity, electronics, drafting, power mechanics, metalworking, etc. We find that a great many of the exhibits at school science fairs have been built, or partially built, in the industrial arts shop or laboratory, or with the help of the industrial arts teacher.

We do not want to become a science or mathematics course, nor do we want to lose our identity as a subject that interprets industry, but we can and should make a substantial contribution in other fields.

At the present time most of our teachers do not have the background to do some of the things proposed. Added courses on the graduate level or work in industry must be obtained by anyone teaching such course. Experience in a paid industrial job should be recognized as the same as a college requirement; in fact, such a requirement for a master teacher would not be out of line. This is the only way we have been able to secure teachers or qualify them for such accelerated courses.

Class size and teacher qualifications seem to be the key to experimental and research work in industrial arts subjects. Such a class should have no more than 20 students. This should also be the second course in high school industrial arts so that time would not have to be spent in teaching tool and machine skills and knowledge.

Basic industrial arts courses in industrial mechanics with content cast in industrial chemistry, electronics, drafting and design, instrumentation and automation, etc., should be and are being developed for college-bound students planning to become technicians, engineers, or industrial arts and trade and industrial education teachers.

Courses in descriptive geometry, preengineering drawing, basic electronics, materials and processes, and others, will help the student bypass college courses, be granted credit, and in many cases allow him to have experiences in a shop or laboratory that will be of value in engineering and science courses. Most engineering schools do not require engineering shop work because of the lack of time and additional theory courses for graduation. Most colleges recommend that students take such courses while in high school. Such a recommendation should be in all guidance handbooks.

A recommended program of industrial arts at the junior high school level should be one that meets the "imperative needs of junior high school youth" as developed and subscribed to by the National Association of Secondary School Principals.

We should analyze these needs in relation to the purposes of industrial arts at the junior high school level and show in chart form our contributions to each of the needs. Some will be greater than others. Our aims need to be specific.

This would give us a common ground with the principal, and 1 to 1½ years or more of required industrial arts for boys should be more than acceptable. Industrial arts for girls should also be proposed and programed.

A program of multiple activities in one or more shops or laboratories, as outlined previously, should be presented with general and specific aims and contributions outlined in lay language. Procedures, methods, and techniques for all industrial arts educators to follow in presenting such a program throughout the Nation would be helpful.

## Discussion Highlights

**Let's not throw things out and start all over again. The structure of our present industrial arts program is sound, but there are segments that need to be upgraded. Every boy and girl should have something to "sell" when he graduates from high school. He should have a broad background and depth in some industrial arts activity. Industrial arts has certain contributions that are unique and we should capitalize on them; but we are not doing this because of the inability of the teacher to dig in and tackle the problems. It would be helpful if some of our accrediting**

associations would develop a minimum program for teachers.

Each junior high school should require a year and a half of industrial arts. This requirement should include girls also. Today, one out of every three women is in the labor force and therefore needs technical understanding.

Teaching a multiple activity shop (general shop) is difficult. It takes a special kind of teacher to conduct this course with success. Normally, teachers rotate students within their classes every few weeks, for example, 9 weeks. In large school systems, general unit shops are established and students rotate between the shops. We should teach a variety of courses—not just woodworking and drawing. No matter what teaching method we use, whether we make it a 9-week rotation, or allow students more freedom to choose projects and pursue their individual interests, it must be a controlled situation. When more freedom is allowed and real problem solving is attempted, more effort, more preparation, and more work is required of the teacher. The range of student ability is great, and one of our problems is that we teach to the "average" student. Also, it is difficult to direct the various work simultaneously toward a common goal.

All students should have at least a basic course for 1 year before taking an experimental or accelerated program in industrial arts.

There is a great possibility for industrial arts in the 13th and 14th years.

Industrial arts at the elementary level (K–6) varies. Some programs have a modified or semi-departmentalized type of program with eight periods a day. Because of time being devoted to physical education, library, and special teacher study, it is almost impossible to add any more time for industrial arts at this level. The limitation of the program of industrial arts at the elementary level, however, provides a good argument for the junior high school work; in many cases this is the first opportunity many students have to experience an organized class devoted exclusively to the industrial arts.

The greatest contribution industrial arts is making in accelerating scientific education is in the electronic, drafting, and power-mechanics courses.

The parallel was made between industrial arts and the emergence of some underdeveloped countries as independent nations. There are distinct stages in their growth. First, imitation of other cultures; second, assimilation of many aspects of different cultures with their own; third, creation of a new and distinct culture with the values of their own interwoven with others. In industrial arts, students act in the same way. First, they imitate, then assimilate, and, finally, create on their own. The imitation stage may be thought of as our basic program. After students have the basic information and skills, they can assimilate and create within their capabilities.

One of our real needs is to show how our program meets the "10 imperative needs of youth." This would show how our junior high school exploratory program meets students' needs at that level and that the program is acceptable to administrators. The junior high school program has in it our "bread and butter" courses. A chart could be devised showing how our specific goals meet the 10 imperative needs of youth. This would give us some common ground for clarifying issues.

In using the general-shop teaching concept (all areas taught simultaneously using the problem-solving approach); for example, in a mass production class project, a teacher sometimes gets the feeling that the work accomplished is not what is expected. On the other hand, he knows that some of the things taught could not have been accomplished any other way. This feeling may reflect lack of confidence in handling a new approach to teaching. Perhaps the student committees were not organized properly, or he expected too much from the students, or they were not properly oriented to this new approach. Getting a perfect mass production project is not really the goal of the mass production experience. This may be the crux of the whole problem—that of not knowing the real purpose behind the activity. Many teachers have never tried using the newer concepts in teaching and the results cannot be evaluated in the traditional way. Teachers should try teaching the general shop and not be so concerned about the number of weeks or other "artificial fractions" of time, but rather be more concerned about what happens to the students.

The normal procedure is to rotate students every 9 or 10 weeks. This does, however, have its drawbacks. For example, it is difficult to coordinate drawing and woodwork. When a rotational organization is used for students in a shop, the organization becomes, in effect, a series of unit shops and thus loses the effectiveness of integrating ideas. When a new teacher is not prepared adequately to teach a general shop, first one instructional unit and then another is dropped from his program until it becomes narrow. Some teachers cannot teach a general shop with only 20 students. Improper methodology results in an ineffective program.

It is futile to argue about a general-shop concept against another concept of teaching until we decide on the kind of program we want. Then we may find that the multiple-activity method of teaching should be used to accomplish it. The first step is that of determining what we want to do. Perhaps what ought to be done is to set forth a new type of program.

**Perhaps we need to identify the program with effective methods for administering the general shop. For example, when drawing is organized to serve the planning aspect of laboratory problems, then the two reinforce each other.**

**Current research at the U.S. Office of Education will indicate what State curriculum guides report about the program. This could be a starting point. It would be unwise to think of it as a minimum program, but it would provide a baseline from which to go forward.**

**An example of a way to upgrade the program is set forth in the booklet on mass production published by the American Industrial Arts Association which gives direction and help. More booklets of this type on different subjects would be useful for every teacher. We need to upgrade what we have. There should be less emphasis, for example, on woodwork and drawing. A guide worked out for the junior high school level would be helpful, because we get most of the boys in grades 7 and 8.**

**One of the things that would be helpful would be for the U.S. Office of Education to identify superior practices in industrial arts in various parts of the country. It was pointed out that a program for this purpose was contemplated, but the American Industrial Arts Association has research already underway in that area.**

# What Competencies Are Needed by the Industrial Arts Teacher To Meet the Challenge of the Future?

*by*

*M. Ray Karnes*

A TREATMENT OF THE PROBLEM of projecting the competencies needed by the industrial arts teacher of the future, to be adequate, must necessarily take into account certain assumptions with reference to: (1) the nature and function of the school of the future and (2) the role and character of industrial arts in that school. Although other papers prepared for this conference deal with some of the fundamental questions confronting industrial arts, the differences in points of view expressed make it appropriate that certain assumptions be delineated, both with reference to the school of the future and in connection with industrial arts in that school.

## Assumptions Concerning the School of the Future

Some of the characteristics of the school of the future which will have an important bearing upon the competencies needed by the industrial arts teacher, if he is to function effectively in that school, are as follows:

*Clientele.*—The school of the future will serve an increasing proportion of the total population of a given age bracket. Only the most severely physically and mentally handicapped will be institutionalized. To illustrate, an increasing proportion of the totally blind and totally deaf will be provided for in the public schools, and, on the aptitude continuum, pupils will range from the barely trainable to the brightest in the population. Even though it was only during the 1950's that the educational level in the United States reached the point where 50 percent of high-school-age youth actually completed high school, and notwithstanding the fact that the dropout rate resulting from efforts to raise the quality of education reached alarming proportions in some communities during the past 2 years, the school of the future will see the great majority of youth through at least 12 years of formal education. The proportion of youth pursuing education beyond the high school will likewise continue to increase.

*Purposes and offerings.*—While some difficult problems will be faced and some hard decisions will be made concerning purposes to which the school of the future should be responsive and the offerings and activities consonant with those purposes, the enrollment of an ever-increasing proportion of a given age group will mean that the school must be multipurpose in character and that offerings must be many and varied. The term "comprehensive" will be truly descriptive of the school, and multitrack programs will be the pattern.

*School size.*—To provide the necessary services and to make available to all the highest possible quality of education at a cost economically feasible, the school of the future must be large. In my opinion, elementary schools should enroll a minimum of 400 pupils, junior high schools 600–1,000, high schools 1,500 to 2,000, and junior and communities colleges not fewer than 2,000.

## Some Assumptions Concerning Industrial Arts in the School of the Future

The assumptions made here about industrial arts are necessarily placed in the context of the good school of the future. Whether the concern be with the science program, the art and music activities, industrial arts, the vocational offerings, or with the educational enterprise as a whole, it becomes abundantly clear that if education is to be provided at that high level of quality demanded in the years ahead the school must be: (1) responsive to the needs of all ranges of abilities and interests, (2) multipurpose in character and comprehensive in its offerings, (3) staffed in accordance with the urgent educational demands thrust upon it, and (4) a large institution. Even though the median school in America is still too small, too inadequately staffed, and too poorly equipped to make quality education feasible, there is not much point in thinking or talking about significant improvements in industrial arts or in any other phase of education in a setting other than one in which quality can be achieved.

Rather than consume time and space here with detailed assumptions and predictions concerning the industrial arts program of the future, may the author of this paper, at the risk of doing violence to both propriety and modesty, call attention to the 14 items enumerated in one of his recent papers;[1] refer the reader to the other papers prepared for this conference, particularly the ones by Olson and Hostetler; refer to such pronouncements as the recent one by Hornbake;[2] and then emphasize the following points:

1. Technology as the dominant element in the culture and the social complexities which it brings will not only suggest a central, integrating purpose for industrial arts, but will influence the derivation of educational goals in general and will thus have impact upon the entire educational venture.

2. Industrial arts cannot be all things to all people. Of particular importance will be the recognition, on the part of industrial arts personnel, of the existence in the good school of the prerogatives of science and mathematics, the arts and the humanities, the social sciences, and especially the educational offerings which are clearly and specifically vocational in purpose.

3. While the central purpose of industrial arts will be to develop real insight and understanding with reference to the technological aspect of the culture, through experiencing as much of it as possible, and while the hard core of industrial arts offerings will be primarily responsive to this purpose, other offerings which may be termed industrial arts will be directed toward other purposes which are primary in importance.

## Competencies of the Industrial Arts Teacher

The clamor for an improved program of industrial arts education is increasing in volume and intensity. Some urge that the program of the past and present be cast aside and that a completely new approach be employed.[3] Others maintain that the present program, with some specific improvements, will meet adequately the educational demands of the future.[4] Even though there be, on the theoretical side, much to commend the proposals presented by Olson, Hornbake, Hostetler, Maley, and others, one hard fact must be taken into account: Whatever improvement occurs in the teaching of industrial arts in the years immediately ahead will occur in existing programs and will be directly and almost entirely dependent upon the competencies, the aspirations, and the efforts of industrial arts teachers and supervisors now on the job. Ninety-nine percent of the existing programs will not be eliminated and replaced with drastically different programs in one fell swoop, nor will the present teachers and supervisors suddenly give way to a new generation possessing the competencies demanded by the new programs envisaged.

So urgent is the need for immediate improvement that the author is sorely tempted to devote the remainder of this paper to the problem of upgrading the competencies of the thousands of industrial arts personnel now in the field. Emphases will be placed, instead, upon the competencies which should be possessed by the new teacher entering the field, with the hope that what is presented will have implications for a program of inservice as well as preservice industrial arts teacher education.

Papers prepared for this conference and many others recently published strongly suggest the necessity of acknowledging two important limitations as one considers the question of competencies needed by industrial arts teachers to meet the challenge of the future: (1) It is completely unrealistic, in fact little short of an absurdity to assume that a given industrial arts teacher can be prepared to function effectively at all age, grade, and ability levels, can teach competently all industrial arts subject areas, and can achieve the central as well as all the secondary objectives in the kind of program which is being envisaged. (2) To assume that an industrial arts teacher can be prepared within the limits of a 4-year college teacher education curriculum to function effectively in a given phase of the quality program envisaged here is equally unrealistic and absurd. Positively stated, then, it seems essential that some degree of specialization be assumed and that a distinction be made among the special competencies required of the various industrial arts instructors if each is to function effectively in a particular phase of the industrial arts program. Further, 5 years will be assumed to be the minimum length of time in which an industrial arts instructor can be prepared to do a professional job in his field.

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[1] M. Ray Karnes. Improving Industrial Arts Education. *Industrial Arts, Teacher,* 19:5, May–June 1960, pp. 5–7.

[2] R. Lee Hornbake. Professional Growth in Industrial Arts Education. *Industrial Arts Teacher.* 19:2, Nov.–Dec. 1959, pp. 13–15.

[3] See, for example, the first two paragraphs of the paper prepared by Olson for this conference, also his doctoral dissertation upon which this paper is based.

[4] See the first three paragraphs of the paper prepared by Ruley for this conference as in illustration of the point of view frequently expressed by teachers and supervisors who are on the "firing line."

*Competencies required of all industrial arts instructors.*—The problem of preparing industrial arts instructors is comparable to that of preparing engineers. Each engineer—be he civil, electrical, aeronautical, mechanical, or chemical—should have certain competencies in common with all other engineers. The competencies required of the science teacher in the high school could likewise be used as an analogy. The physics teacher should have certain competencies in common with the teacher of chemistry and the teacher of biology.

That the industrial arts teacher, every teacher for that matter, should be a broadly educated individual is clearly indicated in the recent article by Hornbake. While he makes the statement in the context of competence in the behavioral sciences, the statement could very well be placed in a broader context when we quote Hornbake: "Just being a good craftsman never was an adequate basis for counting one's self a professional industrial arts educator." [5]

In addition to having experience with and appreciation of the great literature, music, art, and the various art forms and to having knowledge in depth of the history of man and his achievements, the industrial arts teacher should have a high order of competence in the physical, biological, behavioral, and social sciences. Just what part of the teacher's preparation makes him an educated man and what part sets him aside as a truly professional person cannot be clearly indicated. It can be said with considerable assurance, however, as has been suggested by Hornbake, that insight into the teaching-learning process is heavily dependent upon knowledge of the data coming from the behavioral sciences.

Great importance is attached to industrial arts as an area of study which affords ample opportunity for making application of mathematics and science. Both from the standpoint of the adequacy of his basic education for living and working in a technological world and from the standpoint of his ability to supervise the applications of mathematics and the principles of science to technological problems in the industrial arts laboratory, the industrial arts teacher simply must have substantial preparation in the physical, biological, and mathematical sciences. Every industrial arts teacher should have more competence in these areas than can possibly be obtained by the brightest pupils who pursue the rigorous college-preparatory program through the high school years. What we are saying here is that the industrial arts teacher, regardless of the level at which he functions, should be better educated for living and working in a technological world than are the brightest of the youngsters who graduate from the best of our high schools.

May we be somewhat more specific about the professional competencies of all industrial arts teachers? Every one of them should be a professional student of the technological aspect of the culture. Aside from the applications of mathematics and science, the industrial arts teacher should, in his pursuit of the social and behavioral sciences, place particular emphasis upon his study of industrial and economic history and geography, industrial sociology, and industrial psychology. Study here must involve a great deal more than simply delving into books and research reports. The kinds of competencies envisaged here can be achieved in large part through study in the school sense, but genuine insight and competence demand that the industrial arts teacher have actual experience in the technological aspect of the culture.

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[5] Hornbake. Op. cit.

Schmitt, in his paper prepared for this conference, makes a case for industrial experience on the part of industrial arts pupils enrolled in the public school as he considered implications of Soviet polytechnic education for industrial arts. If industrial employment is so essential to the achievement of industrial arts objectives on the part of secondary school pupils, how much more important is such employment to the development of the competencies required of the industrial arts teacher? The author of the present paper emphasized this point while making a presentation at a national, professional meeting some 5 years ago.[6] One quotation from this paper stresses the essential condition of this employment: ". . . we generally agree that industrial work experience is highly desirable, though not necessarily essential, to the industrial arts teacher. How valuable and essential might such experience become if we plan it, supervise and coordinate it, and make it an integral part of industrial arts teacher education?" A 5-year, cooperative program of industrial teacher education, involving 25½ months of full-time, supervised, and coordinated industrial employment for pay, has been in operation at the University of Illinois since 1955. While this program was inaugurated for the purpose of preparing vocational-industrial teachers, it has become increasingly clear that the employment feature of this curriculum is equally essential to the preparation of industrial arts teachers.

The industrial arts teacher should have an order of technical competence in exercising control and mastery over tools, materials, and machinery with which he works in the industrial arts laboratory which compares favorably with the competence possessed by craftsmen and technicians who work with these same materials and devices in the industrial setting. There should be a distinctly professional touch to his own performance, and this should be reflected in the performance of his pupils.

Perhaps the greatest single area of need for improvement in the industrial arts field is in connection with teaching methodology. Olson makes an impassioned plea for a new approach to content selection and organization. The author of this paper would make a similar plea for a drastic revision in the approach to teaching industrial arts. Much is said in the professional literature about the advantages of industrial arts from the standpoint of providing opportunity for solving problems and engaging in creative experiences. The typical teaching pattern is, however, such that practically all opportunities for solving problems and participating in creative activities are eliminated. Identifying and solving real live problems, engaging in truly creative activity, researching, experimenting, and exploring should characterize the behavior of the industrial arts pupil, and the teaching process which influences his behavior should be directed to this end. This is a recommendation which is just as valid for the average and for the slow learner as it is for the bright pupil. He could cite many others, but the author points specifically to two pieces of experimental research recently completed and to three other research projects for which reports are now being written.[7]

*The industrial arts teacher in the elementary school.*—Many accept the idea that the industrial arts activities of the elementary school really have purposes which more nearly coincide with the overall purposes of the elementary school than with particular industrial arts functions. It then follows that the industrial arts teacher must in fact be an elementary teacher first and an industrial arts teacher second. Insofar as the lower grades of the elementary school are concerned, he will function as a consulting teacher, and he must have competencies which enable him to meet this responsibility well.

While the necessity of being well-grounded in the behavioral sciences is apparent, the industrial arts teacher of the elementary school should develop special competence for teaching at that level through pursuing the methods and the curriculum courses designed to prepare elementary teachers, rather than the traditional professional courses in industrial arts education. He should augment his studies of sociology, anthropology, and psychology with pursuit of knowledge in the area of child growth and development.

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[6] M. Ray Karnes. Current Issues and Problems in Higher Education: How Their Solution May Affect the Preparation of Industrial Arts Teacher. A paper presented at the 1955 convention of the American Council on Industrial Arts Teacher Education. See pp. 7–9.

[7] Willis E. Ray. An Experimental Comparison of Direct and Detailed and Directed Discovery Methods of Teaching Micrometer Principles and Skills. Urbana, Ill.: University of Illinois, 1957. (Unpublished doctoral dissertation.)

John D. Rowlett. An Experimental Comparison of Direct-Detailed and Directed Discovery Methods of Teaching Orthographic Projection Principles and Skills. Urbana, Ill.: University of Illinois, 1960. (Unpublished doctoral dissertation.)

Hypotheses similar to the ones tested by Ray and Rowlett are also involved in the studies now being completed at the University of Illinois by Jerome Moss, Jr., Nelson Grote, and Robert Tomlinson.

*The junior high school teacher.*—Two facts are apparent here. The profession of education has experienced a greater difficulty in developing adequate teacher education programs for the junior high school level than for any other level of school work. The same can be said for programs designed to prepare junior high school teachers of industrial arts. While industrial arts came into the junior high school as a part of a greater movement in the direction of bridging the gap between the elementary and the secondary school, it suffers by comparison with such areas as social studies and language arts and the sciences. If the general shop is to remain the typical pattern of organization for industrial arts at the junior high school level, the profession still faces, and will continue to face, a most difficult teacher education task. The teacher of the future who operates at this level must undoubtedly have a great deal more technical competence, more breadth as well as depth, and must know much more about the adolescent than is true of the typical industrial arts teacher of today. In the setting of the large, good school previously described, there is some hope that the possibility for a higher order of specialization which this school makes possible will lead to a breakthrough in the preparation of junior high school teachers. *Agreement upon a clear definition of function and an acceptance of the central purpose of industrial arts as being that of interpreting the industrial aspect of the culture*, rather than developing hobby interests and competencies and many of the other objectives so glibly stated, will again tend to delimit and simplify the problem of developing the competencies required.

*The senior high school teacher of industrial arts.*—The good school of tomorrow will demand that the industrial arts teacher who functions effectively at the senior high school level will be characterized by real and substantial depth in one major subject matter area. In this regard, he must specialize to essentially the same extent as does the teacher of chemistry, or the teacher of physics, or the teacher of mathematics. Upon the broad background suggested as essential to all industrial arts teachers, he must build his competencies in his area of specialization. Much of the industrial arts work at the senior high school level should become not vocational in the traditional sense, but rather preprofessional in the same sense that the mathematics, science, and communications offerings are for the college-preparatory student who is headed for engineering or for other occupations requiring post-high-school preparation.

In thinking about the competencies required of the senior high school teacher of industrial arts, one should not lost sight of the possibility that much of the vocational work now in the high school will be moved to the post-high-school level. Another important consideration is the possibility that the development of technical-terminal offerings at the post-high-school level may well represent one of the largest and most significant educational developments of the future. The industrial arts teacher must possess the competencies which will enable him to achieve at a high level the central purpose of industrial arts, and in addition he must possess the ability to teach at a depth that will enable industrial arts to function in the same preprofessional and pretechnical sense as do the sciences and mathematics at the high school level.

*Competencies required of special industrial arts teachers.*—There are some industrial arts purposes which might be termed peripheral but which are, nevertheless, important. The realization of each of these requires some special competencies on the part of the teacher who responds to each. If the hobby-recreational objective is a legitimate one, for example, the industrial arts teacher who seeks to achieve this purpose must have not only the broad preparation demanded of all industrial arts teachers, but also much of the professional preparation of the recreational expert. If industrial arts personnel are to continue to move into the fields of occupational and manual arts therapy, they must, in order to perform their tasks well, possess the additional competencies required of the therapist. If industrial arts teachers are to develop special programs, along with personnel from other practical arts areas, for the slow learner and the mentally retarded, these teachers must become professional students of the problems of this particular group and they must be thoroughly conversant with the purposes of education of particular importance to this group.[8] These are only some of the examples in which special competencies are required in order to achieve effectively the particular purposes which might be termed peripheral.

## Concluding Statement

The teacher is the key to the improvement of industrial arts education in the public school. While drastic improvements may be urgently needed in many local public school programs, the most critical need, in terms of the long haul, is in connection with improvements demanded at the teacher education level.

## Discussion Highlights

**Schools must be large enough to provide quality education. A small school cannot do this adequately. Conant also argues for schools of a certain size in preference to small ones.**

**The improvement needed will come from the supervisors and teachers now on the job. We will have to work with present personnel, but this should not prevent us from devoting efforts to develop an imaginative, high level teacher-education program in industrial arts.**

**Two of the competencies industrial arts teachers need in order to carry on the kind of program desired in the public school are: (1) basic preparation in the areas of mathematics and science and (2) actual experience in industry, not just "work experience," but a supervised and coordinated program by a teacher-education institution.**

**It is beyond reasonable expectations to develop teachers who would be able to function equally well at all levels of the industrial arts program in a large school. For example, teaching industrial arts to mentally retarded children calls for special training in understanding them. Different methods must be used involving a good deal of individual instruction, freedom, and opportunity to work with concrete materials—a real challenge for an industrial arts teacher. But, an additional load of a special class without special preparation increases appreciably the teacher load, discipline problems, and the possibility of injury. Therefore, teacher education programs should be designed to prepare specialists. Perhaps 1 in 15 or 1 in 20 prospective teachers should be prepared, for example, as teachers for specialized industrial arts classes for mentally retarded students, or for manual arts therapists, etc.**

**One place where we, as teacher educators, have fallen down is in the preparation of a teacher with real depth, not in just one area like machine shop, but in general metals. Supervisors and personnel officers can't find anything but a general shop teacher.**

**Since teachers are the key to improvement, whatever improvement comes in the next few years will have to come through the teachers now on the job. This would imply that an inservice program of considerable magnitude should be initiated to improve teacher competencies.**

**One of the problems is that we lose so many of our prospective teachers to industry. This is a commentary on the preparation of industrial arts teachers since their services are in demand other than in teaching. We will, no doubt, continue to lose some teachers this way.**

**Some areas of education that should have emphasis in future teacher-education programs, if we consider the total program and not the professional industrial arts course, are the following: (1) good grounding in sociology, economics (in particular industrial economics), and psychology; and (2) understanding labor and industrial relations.**

**Is it not true that supervisors complain that they can't get teachers with enough technical preparation? Yet others feel we have too many technical courses at the expense of liberal arts courses. The real problem here is that there is not enough time in 4 years to prepare teachers adequately.**

**Perhaps we should compare teacher-education programs with those for medical doctors. Physicians will tell you they have to continue to go to clinics to learn new information and techniques.**

**There are many conferences, seminars, and inservice programs that teachers do attend. Perhaps if we had teachers in an inservice-training program for 1 night a week for a year, we would see considerable improvement. What we need to do is to spend some real effort and develop this program in a systematic way. We should bring in others, such as outstanding physics teachers or industrialists, to instruct at these inservice classes.**

**An area in teacher education that needs considerable attention is methodology. It has a bearing on teaching the general shop and the general unit shop. It involves group work and individual work. Is it better to rotate students through a series of experiences, or are we more interested in the student and**

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[8] **M. Ray Karnes. Industrial Arts and the Education of the Mentally Retarded of Secondary School Age. A paper presented at the 1958 convention of the International Council for Exceptional Children.**

**what happens to him? Many sociological implications are here. In industry people often work in teams. We talk about problem-solving, but the methods we employ in teaching determine how effectively we reach this goal. There are some publications available at the National Education Association that assist teachers in experimenting with problem-solving and the unit approach to teaching. These are particularly worthwhile reading: *Teaching Industry Through Production* and *The Unit Method*.**

**We could make more progress if workshops could be established, not necessarily directed, from the university level. These workshops should be designed around specific problems and not to fit into a pattern for receiving a degree from some institution. We should, however, draw upon university personnel as resource specialists.**

**Bearing on the importance of methods were the reported research studies of Ray and Rowlett. In the study completed by Ray, some of the major findings indicate that the directed-discovery approach to teaching is superior to direct and detailed instruction with respect to retention of material initially learned as determined 6 weeks after instruction in micrometer principles and skills. The directed discovery method of teaching is more effective than the direct and detailed approach in enabling students to make wide applications of information learned to new and related situations, both at 1 and at 6 weeks after instruction. The findings of this research not only hold implications for the education of the slow learner, but the evidence presented supports the proposition that the directed-discovery method of instruction may be superior for all levels of intellectual ability with regard to retention and transfer. Teachers who use techniques that lead students to discover relationships and draw conclusions from their own discoveries may provide the opportunity for them to apply their learning more effectively to new situations and to retain more of what they initially learn. Although both methods require a mastery of subject matter on the part of the teacher, the directed-discovery method entails more guiding and less showing, instructed searching in contrast to telling. A study by Rowlett dealing with teaching orthographic projection principles and skills reported similar findings.**

## CHAPTER II

# Recommendations and Suggestions for the Profession To Consider

After the working papers had been given and discussed, the conference was summarized and recommendations were made. Suggestions were also made for the profession to consider during the years ahead—suggestions gleaned from the fundamental ideas of the conference itself.

## Recommendations

1. It is recommended that industrial arts teachers, supervisors, and teacher educators critically analyze their past performance with the aim of providing better instruction and inaugurating pilot programs that can test new ideas. These pilot programs can be a *real adventure in learning*, not only for the students, but for the investigator as well. The local teacher, students, and administrator should all be involved in setting up goals, procedures, techniques, and evaluations. This action research carried on at the local level can provide the stimulus to upgrade programs.

2. It is recommended that a coordinate effort be made to attack professional problems on a "cluster research basis." This would involve the identification of problems and segmentation of them so that the cluster research bears on a particular problem. The cumulative effect of this procedure could reduce the time necessary to find solutions to pressing problems.

3. It is recommended that teacher-education institutions provide for more programs for inservice education and for curriculums at the undergraduate level so that students can specialize in specific programs. This is especially true at the senior high school level for courses in electricity and electronics, power mechanics, and for teachers who wish to specialize in teaching handicapped children, etc.

4. It is recommended that the U.S. Office of Education consider having meetings such as this on a continuing basis, not every year, but periodically.

5. It is recommended that the working papers and proceedings of this conference be published so that others working in the field can share some of the ideas and points discussed here at the U.S. Office of Education.

6. It is recommended that the U.S. Office of Education issue a call to the profession to stimulate teachers to attack their professional problems vigorously and that State and local groups throughout the country hold a series of small conferences. Groups of teachers working together to clarify issues and exchanging ideas could, they believe, move the profession forward on a sound basis. Clearly the participants considered the Office conference as only a beginning of better education in industrial arts, for they realized that little progress could be made without the support of all teachers.

7. It is recommended that the U.S. Office of Education publish a short release to the profession summarizing the conference as soon as possible.[1]

## Suggestions

The conferees invite the profession to consider the following ideas which emerged from the working papers and deliberations. Further amplification and clarification can be obtained by reading the full report. In the main, these statements reveal some of the present thinking of the group and provide the profession with some fundamental thoughts regarding industrial arts in the public schools of the United States, which may be of value to the profession in years ahead.

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[1] NOTE: An article entitled, Industrial Arts Education: A Call to the Profession, by Marshall L. Schmitt, summarizing the conference, was released in *School Life*, the official journal of the U.S. Office of Education, in October 1960.

1. The fundamental justification of industrial arts for its existence in the public school is twofold. If properly taught, industrial arts can: (1) develop insight and understanding about the technological side of our American society for all students and (2) discover and develop the technical talents possessed by *some* of the pupils in the schools. Industrial arts, therefore, provides a curriculum area to meet the needs of *all* students so that they can understand the kind of technological society they find themselves in and it enables students who possess technical talents to discover and develop them. This Nation cannot overlook any talents possessed by its citizens, but must develop all talents to their fullest.

2. The following four objectives for industrial arts are suggested as a central unifying core:

> (1). To develop in each student an insight and understanding of industry and its place in our culture.
>
> (2). To discover and develop talents of students in the technical fields and applied sciences.
>
> (3). To develop problem-solving skills related to materials and processes.
>
> (4). To develop in each student a measure of skill in the use of the common tools and machines.

3. Teachers should establish guidelines to be used as criteria to test the appropriateness of the content to be taught and the projects to be undertaken in industrial arts. The guides presented in the working paper are in outline form and are merely suggestions—they should not be thought of as being a complete set of guides for a program.

4. The instructional content taught in industrial arts ought to bring about more emphasis on the understanding of fundamentals of production, the application of mathematics and science in industry, and the development of desirable attitudes toward work.

5. Although it is important to know the relationship of industrial arts to other courses, it is suggested that industrial arts teachers consider providing more meaningful intellectual experiences in their own subject matter areas as well as more meaningful manipulative experiences.

6. It is suggested that teacher-education institutions consider: (*a*) providing more preparation in mathematics and science, industrial and economic history and geography, industrial sociology, and industrial psychology; (*b*) utilizing resource persons to assist them, such as engineers and scientists; (*c*) extending the 4-year curriculum to 5 years in order to provide more nearly adequate specialization (depth and breadth) for teaching at the elementary and junior and senior high school levels; and (*d*) teaching prospective teachers how to instruct students who possess a wide range of abilities.

7. It is suggested that much more effort be put into inservice-education programs for teachers presently on the job. Considerable increase in this area would reap rich rewards in the next few years.

8. It is suggested that another look at our definition of industrial arts would be in order. In the working papers and discussions at the conference, four separate definitions were proposed. These definitions point to efforts of the participants to redefine, rethink, and reexamine industrial arts in the light of current changes in society. The four definitions are grouped together for convenience in reporting and are cited as follows:

> Industrial arts is a laboratory-classroom experience designed to orient students to our technological culture. Problem solving through analysis, planning, designing, production, and evaluation is the basis for laboratory activities. Analysis of industrial occupations, cultural patterns, the nature of planning and engineering as a problem-solving technique, tool design and use, and the nature of materials provide the basis for classroom study and field trips.—Hostetler.

> The industrial arts is a curriculm area in the public schools which provides the setting for pupils to learn about industry—the user of science—and to experience the act of creating from materials new and different forms which have human value. In so doing, students are able to understand and be sensitive to materials, processes, operations, machines, tools, mass production, opportunity for work, quality of products and services, maintenence, safety, and the significance of technology and its effect on society and on the individuals within that society.—Schmitt.

> Industrial arts is that part of a total educational program for all youth which is concerned with the the development of a practical understanding and appreciation of today's industrial and technical society. Opportunities for learning are provided through experiences in planning, using tools and materials, performing processes in the production of useful articles, servicing industrial products, and experimenting in activities related to the science of industrial and technical problems of the world today.—Ketcham.

> **Industrial Arts is a study of the technology, its origin and development; its technical, consumer, occupational, recreational, social, and cultural nature; and its influences through experimenting, creating, designing, inventing, constructing, and operating with industrial materials, processes, and products. Its purposes are to acquaint the student with his technological environment and to aid him in the discovery and development of his own human potential.—OLSON.**

**9. It is suggested that special courses be established for academically talented pupils in industrial arts.**

**10. Teaching the general shop is admittedly a difficult problem. Two general methods are used: (1) The problem approach where a definite central theme is identified and students work simultaneously in all instructional activities in the general shop and (2) the rotational method where students work in specific instructional activities for a specified number of weeks and then are rotated to other instructional activities. It is suggested that, rather than point out the merits of the two methods of instruction, it might be better, first, to specify more definitely what the educational program is to accomplish; and, second, to develop content, teaching methods, and administrative procedures that will permit the goals of the program to be achieved.**

**11. As in all conferences, although some problems were clarified others emerged; and we found that older problems and issues need continual inspection and reevaluation. Some of the more important problems which the profession may wish to consider in future conferences, workshops, State and local meetings, are the following: *(a)* What is the place of skill in the industrial arts program? *(b)* What is the "hard core" of industrial arts? *(c)* Is problem-solving an objective? *(d)* What is the place and function of industrial arts at the elementary school level? *(e)* What programs should be developed for the academically talented student? *(f)* What is a minimum program for elementary, junior, and senior high school industrial arts? and *(g)* What methodology proves best and under what conditions? (h) What should be the minimum foundation industrial arts teacher education program?**

# Appendix. List of participants

**Charles E. Bish,**
Director, Project on the Academically Talented Student,
National Education Association,
1201 16th Street, NW., Washington 6, D.C.

**John Fisher,**
Instructor, Industrial Arts High School,
New Hope, Bucks County, Pa.

**Leonard W. Glismann,**
Director, Industrial Arts Education,
State Department of Public Instruction,
Salt Lake City 14, Utah

**Rodger H. Hicks,**
Instructor, Industrial Arts Department,
Wakefield High School,
4901 South Chesterfield Rd., Arlington 6, Va.

**Paul T. Hiser,**
Professor, Industrial Arts Teacher, Education Department,
State University of New York Teachers College,
Oswego, N.Y.

**Lee Hornbake,**[1]
Vice-President in Charge of Academic Affairs,
University of Maryland,
College Park, Md.

**Ivan Hostetler,**
Head, Department of Industrial Arts,
North Carolina State College,
Raleigh, N.C.

**John A. Jarvis,**
Dean, School of Industrial Education,
Stout State College,
Menomonie, Wis.

**M. Ray Karnes,**
Professor, University of Illinois,
Urbana, Ill.

**G. Wesley Ketcham,**
Consultant in Industrial Arts, State Department of Education,
Box 2219, Hartford, Conn.

**Edwin L. Kurth,**
Consultant for Industrial Arts, State Department of Education,
Tallahassee, Fla.

**Donald Maley,**
Head, Industrial Education Department,
University of Maryland,
College Park, Md.

**Carl W. Neuscheler,**
Department Head, Industrial Arts Department,
Brockport High School,
Brockport, N.Y.

**Delmar W. Olson,**
Industrial Arts Department,
College of Education,
Kent State University,
Kent, Ohio

**Morris J. Ruley,**
Supervisor of Industrial Arts,
Board of Education,
Tulsa, Okla.

**Marshall L. Schmitt,**
Chairman of the Conference,
Specialist for Industrial Arts,
U.S. Office of Education,
Washington 25, D.C.

**Robert L. Woodward,**
Consultant in Industrial Arts Education,
State Department of Education,
721 Capitol Ave., Sacramento 14, Calif.

Office of Education personnel who attended some of the conference sessions include: Edith S. Greer, Specialist, Curriculum Coordinator; Willis C. Brown, Specialist, Aviation; Albert L. Pelley, Research Assistant; J. Dan Hull, Director, Instruction, Organization, and Services Branch; Jane H. Franseth, Specialist, Rural Education; Earl M. Bowler, Assistant Director, Trade and Industrial Education Branch; Merle E. Strong, Specialist, Teacher Training and Services Studies; George A. Male, Specialist, Western Europe; Edmund A. Ford, Specialist, Organization and Administration; Clarence B. Lindquist, Specialist, Mathematics and Science; Nicholas J. Rokitiansky, Research Assistant; and Wayne O. Reed, Deputy Commissioner of Education.

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[1] Unable to attend conference, but prepared working paper.